

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. XXIV.

MAY 17, 1889.

No. 599.

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UNIVERSAL SYSTEM OF TELEGRAPHY.

WHENEVER we hear of a gigantic project, or an exceedingly striking invention, we have hitherto been accustomed to turn our attention to America, in the expectation of there meeting with the originator, and we have rarely been disappointed. The Americans have, however, now been outstripped by the French in the person of M. Eiffel, who has shown what Frenchmen can do by the construction of the tower which bears his name. Another remarkable, and at the same time, absurd project, was recently brought under the notice of the French Ministers of Commerce and of Posts and Telegraphs by M. Léon Roquet, who proposes the institution of a universal telegraphic language, which he claims would be of great service to the public. The project, as described by the author, is as follows:—

"In private, commercial, and administrative telegraphic correspondence there is a large number of phrases which are very frequently employed, and it would be quite easy to replace these phrases by conventional combinations of figures and letters, such combinations to be published by the Administration. In order to collect and make such combinations, the telegraphic correspondence for the past few years would have to be investigated, so that the most frequently employed phrases could be noted and classed in a methodical manner in order to avoid repetitions. In front of each phrase would be placed either a figure or letter of the French or Greek alphabet. Suppose we have 50 elementary signs, figures, or letters. Fifty phrases, each distinguished by a distinct sign, would form a page. At the top of the page there would be placed one of the 50 signs, and each group of 50 pages would form a part. A volume would consist of 50 parts, each of which would be distinguished in the same manner. Fifty volumes would comprise a repertoire, and 50 repertoires a series. For instance, one page would contain 50 phrases, a part would comprise 2,500 phrases, a volume 125,000, a repertoire of 50 vols. 6,250,000, and a series 312,500,000 phrases."

"The author suggests that probably one volume of 125,000 phrases would be sufficient. With this system any one desiring to telegraph by conventional signs would consult the volume in the same manner as he would refer to the Directory to find an address. Suppose a telegraph clerk were to receive the following sign telegram:—*f k 2 d*. He would refer to volume (*d*), part (*2*), page (*k*), phrase (*f*), and finding the signification of the message would write it down upon the usual form to be sent to the addressee. With this system there could be expressed in six or seven letters or figures the elements of a telegram referring to a person's health or business, including the address. As illustrations of the benefits which would accrue from the adoption of this project, the author refers to the rates now charged from Washington to Paris (1s. per word), and from La Martinique (11s. per word) to Paris, and states that a great percentage would be saved in each message. Different nations would agree upon the establishment of a uniform type of volume of correspondence in such a manner that the same combination of three or four letters or figures would correspond to the same thought or phrase in all countries. A universal telegraphic language would then be created, a language written but not spoken."

The idea of the formation of a universal telegraphic language is excellent, but we are inclined to think that there are too many difficulties in the way to allow of such an introduction at the present time, or in the near future. The system of universal telegraphy, as proposed by M. Roquet, is certainly not based upon a rocky foundation, but rather upon one of sand, to be soon swept away. There are several objections to it. In the first place, the compilation of the code books would involve the expenditure of a very large sum of money and loss of time, and it is exceedingly questionable whether different nations could be induced to adopt the language. Its institution would necessitate the employment of a larger staff of telegraph clerks and assistants—certainly a third more than at present—since there would be the additional labour of searching the codes on the receipt of each message in order to obtain the

translation. This increase in clerical labour represents a serious item. Then, again, with Roquet's system the cost of sending a telegram would be reduced, so that the decrease in receipts and the increase in working expenses are of themselves sufficiently weighty considerations to cause the projected language to be rejected. It is exceedingly doubtful whether it would be favourably received by commercial establishments, many of which possess their own private codes, which they would by no means care to relinquish; but what, indeed, would be the effect upon the general public? Suppose an individual is in a great hurry to dispatch a message, and not having at hand a set of code books of his own, he proceeds to the telegraph office to look into those which it is fair to suppose the government would provide. On arrival at the office it would happen in ninety-nine cases out of one hundred that the code books would be engaged, that several people would be waiting to use them, and that the person in question would have to await his turn. This would mean a serious loss of time, more especially as it would often happen that the person using the books on one's arrival would take up a lot of time through his or her ignorance of the code. How three or four letters or figures could be made to correspond to the same thought or phrase in different countries is a problem which we will not attempt to solve, but we have already said sufficient to demonstrate the impracticability and absurdity of M. Roquet's system.

AN elaborate report on railway rates was presented to the Committee of the Electrical Section of the London Chamber of Commerce on Monday. The provisions of the Railway and Canal Traffic Act, 1888, have been carefully considered, and most of the proposed classifications of merchandise traffic and schedules of maximum rates and charges submitted to the Board of Trade by the various railway companies in pursuance of the provisions of the above Act have been examined. A careful comparison of these proposed classifications, in so far as they affect goods with which the electrical industry is concerned with the railway clearing-house general classification of goods at present in force, has been made, and a schedule to the report contains a comparative statement of the existing and proposed classifications of such goods. The proposed revised classifications were submitted by the railway companies to the Board of Trade in February last, and the Board of Trade has extended the time for receiving notices of objections till June 9th next.

THE category in which an article is placed determines the rate at which it is to be conveyed, and hitherto a revision of a rate was obtainable by a transfer of the article from one class to another. The classification to be made by the Board of Trade will, however, be permanent, and will be unalterable, when once adopted by Parliament, except by a new Act. With certain exceptions the revised schedules adopt the clearing-house classifications. The signs have, however, been varied.

THE most serious variation in the proposed classification is the *entire omission* of the item "dynamos

and electric machinery." The effect of this omission is that electric machinery might be classed either under "machines fitted up or partly fitted up not otherwise provided for," not packed, class 4, packed class 3, or under class 5, the highest category, by being brought under the general definition of "all articles, matter, and things not hereinbefore classified." Although this is the most important objection to the proposed classification, which the compilers of the report think should be strongly raised in the interest of the whole industry, there are no doubt several other modifications which can be shown to be unjust and unreasonable. The classifications call for the most careful consideration of the various branches of the industry, but care should be taken not to multiply needlessly the objections to be raised. For instance, although "storage batteries" have been removed from class 2 to class 3, they can still be conveyed at class 2 rates by being declared as "electric accumulators."

THERE are a variety of other questions arising out of the provisions of the new Act, and of the proposed schedules of maximum rates and charges, and of the general conditions submitted by the railway companies which merit the attention of manufacturers and traders in the country—*e.g.*, the general conditions which are proposed by the companies to govern the traffic, the question of terminal charges, the rates for small parcels, &c.; but as these are not of special concern to the electrical industry, the report recommends that the Electrical Trades Section should in these matters act in concert with the other sections of the Chamber.

IT would be well, however, for every member of the Electrical Trades Section to obtain the proposals of the railway company or railway companies of his district and examine and report on such questions as the selection of "large towns" and "terminal stations," which have an important bearing upon the charges the companies will be entitled to make in respect of services before and after conveyance by rail.

WE hear that Mr. Edison has constructed a double transformer which performs two transformations, first turning currents of high tension into motion and then in the same revolving armature turning the motion into a current of low and safe pressure. It is said that he can also effect both these transformations without turning the armature at all! Wherein does the first part of his project differ from that of Paris and Scott?

IN some experiments by Prof. Braun on the production of electric currents by bending metal wires, he has shown that the greatest development of current is produced by the elongation or compression of a nickel wire wound in the form of a spiral spring, and that the current flowing while extending the spring runs in the opposite direction to that in which the wire, during its manufacture, had been drawn through the plate. In the absence of any precise details as to how these tests were conducted, we would suggest that the same effects might possibly have been produced by heating.

THE superior advantages to be derived from the use of electricity for the propulsion of tramcars, even when on a small scale, is evident from the result of four months' working with five cars at Davenport, Ia. The electric cars, in comparison with the horse-drawn cars

for the corresponding period during the previous year, have earned 56 per cent. more gross takings with a net increase of 230 per cent.

THE Telpherage or Transportation system brought out by the Port Electric Company of New York may be called ingenious, but it will be expensive to construct, and at the best can only be available for small weights. The system is worked by utilising the power possessed by a coil of wire, through which a current is flowing, to draw in, and maintain in a central position, a bar of iron having one end placed near the centre of, and in a line with, the axis of the coil. If a second helix be placed in a position similar to that which the first occupied in relation to the bar, and the current in the first coil be interrupted and transferred to the second, the iron bar will be moved forward; then by increasing the number of helices, and providing arrangements for making and breaking the current, a continuous motion will be given to the bar of iron. In practice, the iron bar takes the shape of an elongated box of thin steel, which is magnetised. This carrier has a runner wheel at each end. The track on which it runs consists of a single lower rail, and the car is guided by two flanged wheels running on an upper smaller rail. The car is arranged to pass through a continuous line of wire coils which are completely covered and protected from the weather. When the apparatus is working, the current flows through the lower rail, round the working coil to the other side of the main line conductor. The make and break of the circuit through the helices is accomplished by means of a pivoted magnet acted upon by the magnetised car body; the break of contacts takes place just before the centre of the carrier reach the centre of a coil. To stop the car at a terminal station, it is only necessary to provide the coils at that spot with contacts that do not, like the others, break before the carriage reaches the centre of a coil, but remain closed, whereby the car is retarded or pulled back, and very rapidly brought to a standstill.

IN a recent number of the *Scientific American* an interesting description of the electric subways of New York is given, together with the method of drawing the cables into the ducts. This account, which is accompanied with illustrations rendering the description more interesting, comes at a good time, as it follows upon the paper recently read by Mr. J. B. Verity upon "Underground Conduits." The streets of New York City are, as is well known, perfectly straight, and there is no difficulty whatever in having each manhole exactly in a line with those on each side of it. This will be the same in most American cities, and the difficulty of drawing cables through the ducts is therefore considerably reduced. In our towns, however, the streets are by no means straight, and drawing in our cables is frequently a matter of difficulty in consequence of their having to be pulled round a curve where friction is naturally increased.

WITH our single pipe system it has been usually the plan to leave in the pipe as it is laid down a wire of small gauge, which, when the line is complete, can be used to pull through a strong drawing-in wire or rope. In New York, however, with their straight ducts and decreased distance between manholes (about 84 yards) they employ other methods. That described by our

contemporary is of using short wooden rods of about 3 feet long tipped with brass male and female screws at the ends. These, as they are jointed together, are pushed into the duct until the opposite manhole is reached, when a small cord is fastened on, the rods at the opposite manhole are unscrewed and drawn out and the end of the cord is obtained. A strong rope is then drawn through. This method of jointing rods is similar to the ordinary plan adopted by our "chimney sweeps" in operating their sooty ducts. It could not be used in our streets in consequence of the small size of our drawing-in boxes.

THE old-fashioned device of leaving a wire in the pipe has been usually found to answer remarkably well, but accidents, to our knowledge, do sometimes happen, and the wire gets broken, and for a time consternation prevails. By using a stronger wire with its end hooked run in from one end, and another from the opposite end, it is frequently possible to twist the wires in such a way that they will engage, and the one can be used to draw the other through. It, however, happens that the distance may be too great for this feat to be accomplished, and opening the ground midway and breaking a pipe becomes a necessity. We are, however, aware that in the early days of telegraphy this difficulty has been got over, not by copying a chimney sweep, but by obtaining the aid of a rat-catcher. The insertion of a rat into the pipe, who was persuaded to travel to the opposite end by the close attention of a ferret was found to be successful where a fine string had been attached to the latter.

THE mammoth combination arrangement progresses, we regret to say, seemingly apace. The names of the Electrical Power Storage Company, Limited; Elwell-Parker, Limited; Woodhouse & Rawson, Limited; the Metropolitan Electric Supply Company, Limited; are mentioned as being probably comprised in the scheme soon to be brought forth, the said scheme to include, also, the purchase of the Sprague (American) system of electric tramcar propulsion for Great Britain, and other businesses of less dimensions than those first enumerated.

WHEN we express regret above we do so because if the scheme is carried through we think it will result in a heavily loaded company, doing, possibly, only half the amount of business the undertakings are likely to achieve if worked separately. Then, again, regarding the new company as an investment, it must be remembered that some of the companies to be purchased have as yet never paid any dividend, although one or two of those in this category show promise of doing so in the near future; the Metropolitan Company has practically done but little work, and the Sprague system has not been yet started here.

That the directors of some of the concerns mentioned should be glad to see the prices of their shares at something like par value we can quite understand, but the scheme is apparently put forward for speculative purposes, and we therefore are sorry to see any substantial businesses involved in such arrangements. A glance at our "City Notes" may reveal something interesting so far as one of the parties to the combination is concerned.

REMARKS ON FRANZ WILKING'S "CONTRIBUTIONS TO THE HISTORY OF TRANSFORMERS."

By A. GELYI.

I FIND in the *Electrotechnische Zeitschrift* (part VIII.) a lengthy treatise bearing the title above quoted. The author endeavours in his "Contributions" to demonstrate that the system of transmission to a distance with alternating current transformers in the form exclusively applied at present, as described in the German patent, No. 33,951, was already known prior to the application for this patent, and consequently it could not at that time form the subject matter of a patentable invention, and hence it may be utilised by competitors without fear of legal proceedings.

Although the author carefully seeks to cloak this tendency, it cannot for a moment escape detection by readers who are acquainted with the circumstances of the case. It forms, in fact, the only *raison d'être*—though of doubtful value—for the treatise in question.

Herr Wilking might have well spared himself the trouble of collecting "materials for the history of transformers," since far more copious materials already exist in earlier publications, and have been treated in a very thorough-going and practical manner, especially in Uppenborn's "History of Transformers" (Munich and Leipzig, 1888).

The author begins with a narration—doubtless very pathetic to simple minds—of all the disgrace which was awarded to the transformer before its value was recognised, until at last this Cinderella "came forth from its hiding place to attract anew the general attention and give scope to the boldest hopes." This Herr Wilking calls the "history of the transformer in bold outlines," which he leaves to be completed by others. His task—as he admits in an unconscious moment—is not to present the history of transformers, but to "throw a passing light" upon certain points which "hitherto have not received a due appreciation."

The explanations of Herr Wilking on the distinctions between inductorium, secondary generators and transformers, if not novel, are, at least, perfectly correct. But the immediately following assertion that there is no practical need for such distinctive names is perfectly erroneous. For from a practical point of view these distinctions are decidedly of importance, since each of the appliances just named subserves especial purposes, quite distinct from each other.

In his endeavour to demonstrate the want of novelty and the non-patentable character of the system of distributing currents by means of alternating current transformers known under the joint name of Ziperowski-Déri-Blathy, Herr Wilking adopts the same systematic procedure which he has learnt from his numerous fore-runners in this field. He adopts the strategem of dissociating the elements whose organic combination constitutes the subject matter of the invention, and to treat them in such a manner as if no mutual cohesion existed between them. The unprejudiced reader is to be prevented from recognising the fundamental idea of the invention and its technical importance there where they, in fact, exist, i.e., in the combination of several known means to a new and desirable end.

Of course, in opposition to such tactics, it is not sufficient to refute the author's allegations point by point, because it is not so much these assertions in themselves as the intentional ignoring of facts, and the endeavour to present the whole position of affairs in a false light which have led me to a reply and a rectifying criticism.

Before passing over to the several contentions of Herr Wilking, I will therefore, for the benefit of the unprejudiced reader, briefly sketch the position of affairs when the Ziperowski-Déri-Blathy system of distributing currents made its appearance, and which secures to this system the attributes of a genuine invention.

The distribution of electrical energy for the purpose of lighting on a large scale is a problem which only began to exercise electricians when the glow lamp had

come into general use. During the days of arc lamps, the distribution of electrical energy, in the strict sense of the words, could not come into consideration. The endeavours of electricians, both in the case of the direct or the indirect supply of currents by means of induction apparatus, were limited almost exclusively to improvements or innovations in partial structures, or to the attempt to render the lamps in a circuit as far as possible independent of each other.

With the invention of the glow lamp there arose the endeavour, or rather the pressing necessity for a real system of distributing electric currents, and such a one was soon developed by Edison. The fundamental principles of this system were very fully and clearly explained by Deprez in the *Comptes Rendus* for 1881, as it is mentioned by Herr Wilking.

But the system of Edison or of Duprez forms only an imperfect solution of the problem, since it allowed of an economical and convenient distribution of the electric energy only within boundaries which are relatively very narrow. In comparison with the very low tension with which glow lamps must be supplied in parallel arrangements, very great quantities of currents must be applied in order to give off a considerable electric energy in extensive stations for distribution.

But currents of large quantity require very large leads, and as the distribution of great electric energies can be generally effected only in extensive districts, the loss of power in the leads, notwithstanding their large diameters, is very considerable, on account of the great distances. This loss, in addition to the great economical disadvantages of increased expense, involves a still more important drawback, the difficulty of regulating the electricity which must be distributed among many consumers.

The economical conditions of a distribution of electricity, as well as the cost of the leads and the loss of power due to their resistance, are at least capable of extension, since they ultimately affect merely the price of the electricity. The other purely technical condition, that of regulation, is a question of existence, since an electric light without regularity, or an electric power without the possibility of control, is useless and worthless.

Many electricians have recognised the transformation of the alternating current by induction apparatus as an effectual remedy for the economical difficulties of distribution. Electricity could be produced in the form of high tension currents of several thousand volts. These currents could be of considerable energy, though with a moderate strength or quantity of current, and thus a great electric energy could be conveyed even to great distances by relatively slender leads.

This was electric conduction, but not electric distribution.

To effect the conduction it was proposed to introduce in the leads a considerable number of induction apparatus, so that they were successively traversed by the current so that the sum of their resistances was sufficient to receive the high tension current. Each induction apparatus could supply one or several lamps in its own secondary circuit. These latter circuits were arranged to suit currents of lower tension.

Many electricians have described such arrangements with trifling modifications, and MM. Gaulard and Gibbs have carried out this principle practically in several installations.

Gaulard's experiments had attracted the most general attention of specialists, and all their colleagues agreed that Gaulard and Gibbs had conferred permanent benefits upon electrical industry, as they have practically demonstrated the possibility of a cheap transmission of great electrical energies to considerable distances for the purposes of lighting. At the same time, however, it was generally felt that a cheap transmission of electricity to a distance can offer a real industrial success only when combined with a corresponding system of distribution, which latter was still to be invented. Recognised specialists, such as Colombo (*Lumière Electrique*, Vol. XIV., p. 43) and Deprez (*op. cit.*, Vol. XIV., p. 45), publicly ex-

pressed this view. Both insisted that the means for effecting a self-acting regulation in an indirect system of current distribution with induction apparatus was not invented.

Not a single voice was raised in opposition to these assertions, which obtained the widest publicity. Though the desired object was clearly pointed out, no one came forward to claim the merit of having reached it.

It is, therefore, decidedly erroneous to maintain—as does Herr Wilking—that after the Turin experiments of Gaulard and Gibbs nothing remained for subsequent inventors (still, therefore, inventors?) save to perfect the production in accordance with general progress, and to adapt the distribution of the current to present circumstances. For, as I have just proved by facts, there remained for inventors nothing less than to *invent the entire system of current distribution*, the want of which was made more than distinctly evident by the above-mentioned experiments of Gaulard and Gibbs.

Such was the position of affairs when Zipernowski-Déri-Bláthy's system of current distribution with non-polar alternating current transformers was made known by its simultaneous production at the Exhibitions of Buda-Pest, London, and Antwerp, and by publication in the technical journals. This system met with vivid and universal recognition. Gaulard and Gibbs alone, as well as Prof. Forbes (the latter in a public lecture), attempted to uphold the superiority of Gaulard's system with secondary generators introduced in succession. The former, in a communication to the *Electrotechnische Zeitschrift* (November, 1885), assert decidedly that they far prefer Déri's parallel introduction to their own series introduction, "*in which it is possible, by acting upon resistances introduced in the thin coils of the dynamo, which serves as exciter, and with a vanishingly small (?!) expenditure of work, to keep at pleasure either the strength of the current or the tension constant, according as their automatic (?) regulator is introduced in the main current, or placed in a lateral circuit at the clamps of the alternating machines.*" Prof. Forbes has as recently as February, 1886, in the Cantor Lectures, pronounced the *parallel insertion of transformers totally impracticable*, since, in the method of insertion described in Déri's patent, the tension decreases from the dynamo onwards, *whence this mode of insertion, which probably no one will apply (?!), is useless*. Since that time these authorities have learnt better, for in 1886 Gaulard and Gibbs have carried out an installation with non-polar parallel transformers, and Prof. Forbes now speaks of the *advantages of Gaulard's (sic!) system of parallel introduction*.

After the importance of the industrial value of the invention had been publicly shown by practical results, envious hostility took the place of the former unanimous approval, and there commenced an unbroken series of attacks, partly open, partly insidious, all seeking to show that the above-mentioned system of distribution was common property before the announcement of the German patent No. 33,951. Herr Wilking has thought it proper, or, rather, necessary to make his appearance in this field as a tardy straggler.

As the first anticipation of the invention described in the above-mentioned patent, Herr Wilking quotes from the *ELECTRICAL REVIEW* of April 1st, 1879 (p. 117), a description of Fuller's system, quite overlooking the fact that the description is an argument for the novelty of the invention in question.

We read in this description:—"The main current was to generate another current in a series of induction coils, and each lamp was to be lighted from one of these coils." Supposing, and admitting that the groups of coils were inserted parallel to the main lead, *though of this there is not one word of mention*, I can prove that this is no system of distribution, since any independence of the lamps and capability of regulation is here impossible.

If a lamp is to be cut out, this would have to be effected by interrupting or short-circuiting the secondary coil concerned, or by short-circuiting the primary circuit. In either case, the modified self-induction must occasion a change in the resistance in

the primary circuit of the series affected. In consequence, the intensity of all the lamps of the series or the secondary station will vary.

If we seek to compensate this variation by altering the tension for the entire series, all other series or groups will experience the change, and burn either too strongly or too faintly.

Hence Fuller could not effect a regulable distribution, even if he used parallel insertions and groups of induction apparatus; and his system was consequently quite incapable of fulfilling the purpose of the invention in question.

The above furnishes, moreover, a decisive proof of the fact that the mere idea of the "parallel insertion of transformers," so far from exhausting the invention described in Déri's patent, does not even embrace its most essential feature.

Fuller's system with transformers and parallel insertion is not at all capable of distributing a current for a fluctuating consumption.

Gordon, also, was far removed from having devised a system of distribution with transformers in parallel insertion. He had not even such a system in view, as the purpose of his invention was merely to facilitate the working of a lamp which he had constructed by suitable induction apparatus and a corresponding insertion. In fact, he proves clearly that the fundamental conditions of distribution, as described in the German patent No. 33,951, were quite strange to him, since he lays the chief weight upon the series arrangement of his induction apparatus, and on the production of a high tension which was necessary for working his lamp. Herr Wilking is perfectly aware of this fact, since he not only admits that Gordon was not familiar with the parallel insertion of glow lamps, but also that he (Gordon) mentions "*in one breath*" all possible insertions of the primary coils, and, consequently, *without understanding their importance*.

Even Rankin Kennedy, whose essay of June, 1883 (*ELECTRICAL REVIEW*, Vol. XII., No. 289, p. 486), is introduced by Herr Wilking, has only proved by his experiments the defects of secondary generators, which in his opinion, and that of authorities in general at his time and long subsequently, render them unsuitable for the distribution of currents.

He has, however, omitted to continue his studies in a positive direction, that is, to examine how his apparatus would behave if applied in another and more suitable manner. He could not ascertain, and, of course, could not state what are the means for rendering these apparatus efficient in distribution.

(To be continued.)

CENTRAL STATION LIGHTING IN PARIS.

MANY of our readers will probably remember that in December last the Paris Municipal Council granted six concessions for the electric lighting of the principal parts of that city; but, so far, full advantage has not been taken of those privileges. Some of the concessions appear to have been abandoned, and the only two concessionaires who are actively pushing on operations are the Edison Company, and the Society for the Electric Transmission of Energy. The operations of the former company are particularly in a forward state, and this is due to the fact of their having purchased from its founders about a year ago the station in the Faubourg Montmartre, and to their having commenced the building of the central station in the Palais Royal several months previous to obtaining authorisation for supplying current. Both these stations, which are considered as the premier in the town, are in operation; but the whole of the machinery is not yet located in that in the Palais Royal. The Edison Company met with many difficulties in the erection of this station, which, for two or three reasons, it was absolutely necessary to establish in one of the courts of the Palais Royal; but the historical character of those buildings

was not to be disturbed in the least. The problem was fortunately solved by M. Chabrol, the architect of the Palais Royal, and by M. A. Vernes, the chief engineer of the Edison Company. These two gentlemen conceived the idea of making a large subterranean chamber under the court of honour. This project was carried into effect, and some of the machinery installed. Then, in order to prevent the service of the station being effected through this court, which it was considered would have been an eyesore, a subterranean corridor opening out on the Rue de Valois was made, and through which entrance the station is reached. The station is 93 feet long by 58 feet wide, and is divided into two parts. One part is the boiler room, containing five Belleville boilers, and it is so arranged that the number of boilers may later on be increased to seven. The supply of the feed-water is assured by three large reservoirs placed under the buildings in the Rue de Valois, and which are filled either through the town mains or from a well by means of two centrifugal pumps, worked by two Edison dynamos of five and twelve horse-power. The smoke passes along a conduit 78 feet long to the chimney, which is in the Rue de Valois, and where also terminates the condensed steam discharge pipe. The coal required is shot down through a trap into cellars placed under the offices in the same street, and from there it is conveyed to the boiler room on a Decauville railway by means of small trucks running along the previously mentioned corridor. The machinery room is behind the boiler room, and contains the condensers, the steam engines, the dynamos, and the distributing board. The steam engines, which are at present four in number, and of the Weyher and Richmond type, are on the triple expansion principle, with four cylinders; they run at 160 revolutions, develop 150 H.P., and when the station is completed will be increased to eight in number. There are four dynamos, running at 350 revolutions per minute, and each of them can supply current, for 1,000 16-C.P. glow lamps. The distribution of the current is on the well-known three-wire system. There is no reserve machinery, but the dynamos are normally run at about half their speed. Should, however, an accident to one of them take place, the others are pushed to a greater output, so that no interruption of the service occurs. The network comprises four principal circuits. Three of these are respectively for the lighting of the Théâtre Français, the Théâtre du Palais Royal, and the buildings of the Administration of the Palais. The fourth is established along the galleries, and constitutes a rectangle completely closed and actually supplied with current by five feeders. The conductors, which are placed in the sewers on the two longest sides of the rectangle which forms the garden, and on the short end, where the station is to be found, are laid on porcelain supports attached to the arches. On the fourth side of the rectangle there are no sewers, and the cables have consequently been laid in an iron conduit.

The branch wires of subscribers are placed in a kind of porcelain shell in order to prevent any injurious contact, and before entering the houses they pass through a locked metallic box. These boxes are for the same purpose as those employed by the Paris Gas Company, namely, to allow of the cutting off of the supply of light without entering the houses of subscribers. The consumption of current is measured by meters, but so far a definite choice has not been made, although trials are being made with meters of the Edison and Brillié types. The two principal customers of the station are the theatres of the Palais Royal and the Comédie Française. The gas jets in the galleries and arcades of the Palais Royal have been replaced by 16 C.P. glow lamps, as have also many of those formerly to be seen in private establishments and shops in the locality. The station at present supplies current for 4,000 lamps, but, when it is entirely completed, its capacity will be 12,000 lights.

The other station of the Edison Company in the Faubourg Montmartre furnishes current for 3,000

lamps, but it is now being greatly enlarged in order to meet the demands for light in that quarter. The horse-power of the station is to be increased to 1,500 H.P. Current is at present supplied by means of overhead conductors, but as the Municipal Council has decided that underground conductors must be employed, the company will shortly effect the change, which will be finished by September next.

According to the subscription policy of the Edison Company, those persons desiring to be supplied with current must subscribe for at least three years, and must guarantee an average annual consumption of 300 ampère hours per 10 C.P. lamp for lighting, or a minimum annual consumption of 600 hours for the supply of motive power. The laying down of branch wires, and the internal fitting up of houses, &c., are at the expense of the subscriber. Current is supplied through the meter at the rate of 4.5 centimes per carcel hour, or, if the subscriber prefers it, at the rate of 15 centimes per 100 watt hours for lighting, and 45 centimes per electrical horse-power for motive power. The subscriber must pay a certain sum as rent for the meter, also the amount of 7 francs for each incandescent lamp, and 30 francs for each arc lamp installed. This total of 37 francs is paid as a guarantee, and the company will return the amount at the expiration of the subscription.

TELEPHONOGRAPHY.*

By M. E. MERCADIER.

AFTER the recent improvements made in the phonograph, in the first place by the inventor, Mr. Edison, and, at the same time, by Mr. S. Tainter, who has given his greatly improved apparatus the name of the graphophone, the problem of telephonography has naturally cropped up. This consists of transmitting to a distance, by a telegraphic line for instance, of sounds or words inlaid, in some way, by the stylus of the membrane of the phonograph on the cylinder of the apparatus, which is covered with tinfoil in the older specimens and with a layer of special wax in those of the new description.

In September last, after having assisted at some experiments made with a Tainter graphophone, I endeavoured to solve the problem above indicated. While waiting for a graphophone to use (that which I had seen being destined for and being afterwards delivered to the Conservatoire of Arts et Métiers), my experiments were conducted with an old specimen of the tinfoil phonograph. The mounting of the membrane of the apparatus was modified, so as to be able to substitute simply for the acoustic horn which is used to speak on the membrane, either a telephone or a microphone.

For the telephone, the mounting of the phonograph was tapped on the interior and that of the telephone on the exterior: the diaphragm was removed and screwed on the mounting of the phonograph till a stop is encountered, disposed in such a way that the poles of the magnet of the telephone are at a short distance from the iron membrane of the phonograph, which can thus serve as a telephonic diaphragm.

For the microphone, it is sufficient to take a disc of fir, on which are mounted in the ordinary way three or four carbon cylinders, and to adjust it in the mounting of the phonograph, so that the carbons are at a short distance from the membrane of the apparatus. It is as well to furnish the sides of the microphone with felt or Indian rubber, in order that the vibrations of the partitions should be communicated as little as possible to the carbons, and that those of the air alone should act on them. It goes without saying, that the use of the microphone necessitates that of the battery and the ordinary induction bobbin.

* *Comptes Rendus.*

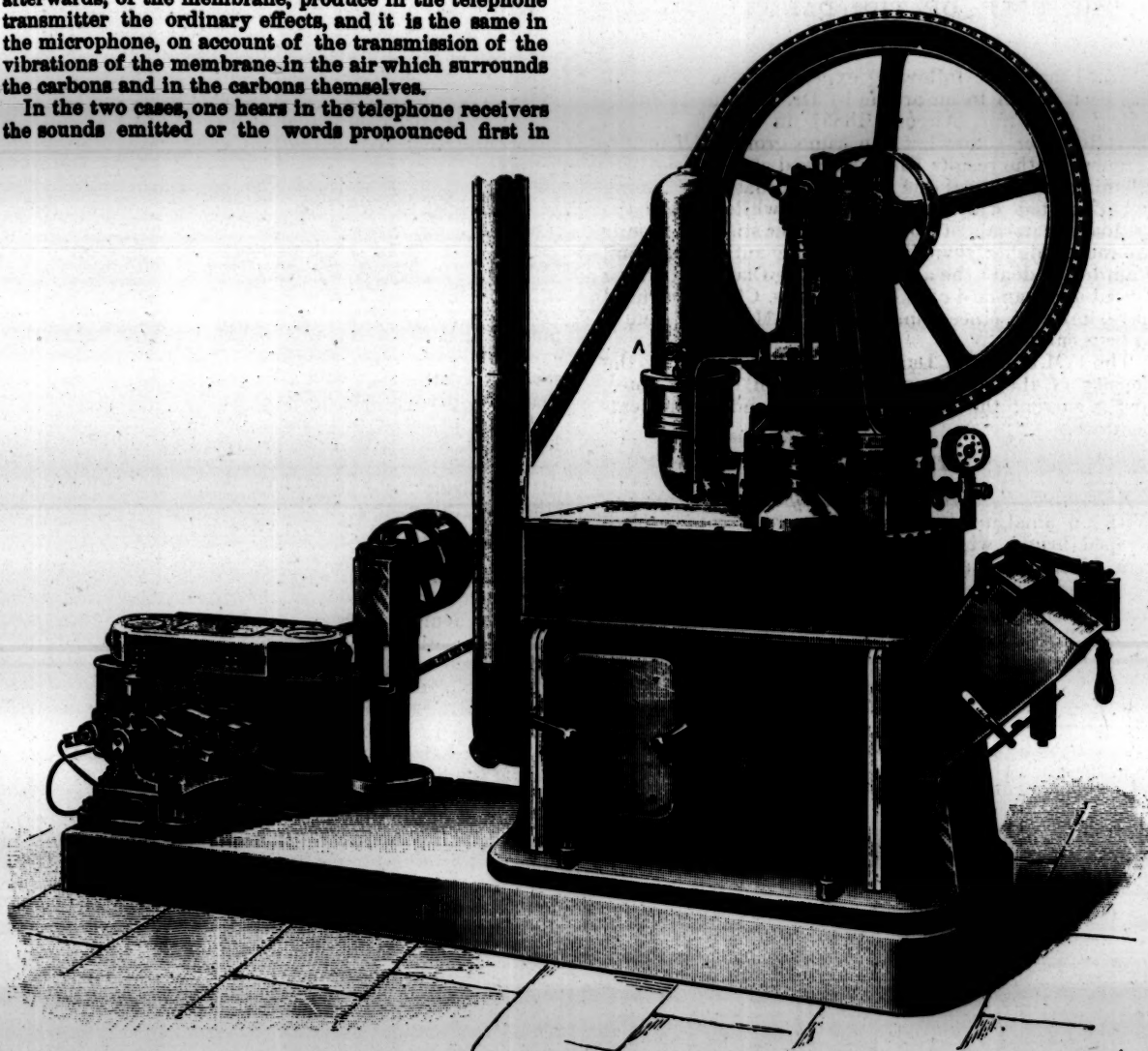
In order to make the experiments, one commences by screwing the acoustic horn on the mounting of the phonograph, and one inscribes on the tinfoil sounds or words pronounced with great energy and clearness, as that is unfortunately necessary to obtain results with this instrument. Then the horn is replaced either by the telephone or the microphone, as already stated, by placing in the circuit, in the same way as in telephonic and microphonic transmissions, two telephones serving as receivers.

Under these conditions, in making the stylus of the phonograph pass over the traces printed in the first place on the tinfoil, the vibrations of the stylus, and, afterwards, of the membrane, produce in the telephone transmitter the ordinary effects, and it is the same in the microphone, on account of the transmission of the vibrations of the membrane in the air which surrounds the carbons and in the carbons themselves.

In the two cases, one hears in the telephone receivers the sounds emitted or the words pronounced first in

THE BAILEY-FRIEDRICH STEAM MOTOR.

MESSRS. W. H. BAILEY & Co., of Salford, are making for the British and Colonial market a steam motor which has already had a successful career on the Continent as an economical, safe, silent, and compact steam engine and boiler. As it appears to possess many, if not all, of the characteristics most to be desired in a motor for electric light installations on a small scale, we have pleasure in giving an illustration, from a photograph, of one of these engines, which, during the past winter, has been running a dynamo supplying 63



THE BAILEY-FRIEDRICH STEAM MOTOR.

the phonograph. This reproduction, despite the transformations of intermediary energy and the losses necessarily resulting therefrom, is very clear, at least as far as reproduction goes; for it naturally preserves the defects inherent to the phonograph, namely: dull articulation, predominance of certain vowels, and alteration of sound, showing itself in a disagreeable nasal sound. Still, on account of the diminution of the intensity of the effects, this latter inconvenience is also notably lessened. The introduction of high resistances in the circuit does not notably change the intensity of the effects received; but the quality is much improved by using phonographs of the improved sorts; it is with one of these that these experiments, made in the month of October, 1888, will be continued on a long telegraphic line.

lamps of 16 C.P. for lighting the show-rooms and offices of the manufacturers. The compactness of the arrangement will be seen from the cut, the engine being placed above the boiler, while the safety consists in the boiler being inexplosible, and in the arrangements made for the automatic regulation of the steam pressure and of the firing-up. The economy of the engine will be inferred from the following particulars:—The steam cylinder being fixed on the top of the boiler, it is thus steam-jacketed. The exhaust steam is condensed by a surface condenser and immediately pumped into the boiler, causing an unvarying water-line, which is maintained by the addition of about two quarts of water per horse-power per day.

This economy of water is of greater value than may be seen by the casual thinker, for it must be remem-

bered that the small amount required enables water to be used that otherwise would be unfit to use for boiler purposes. It goes without saying that this frugal use of water in sending the condensed steam into the boiler instead of using cold water for feeding also saves a very considerable amount of coal. Incrustation is also avoided, and the life of the boiler much prolonged.

In the electric lighting of mansions, theatres, hotels, and for isolated plants of all kinds these engines should meet a large demand.

THE E.M.F. OF THE DANIELL CELL.

SINCE I made the following experiments my attention has been drawn to an article by Dr. Fleming (*Philosophical Magazine*, August, 1885), in which he has travelled over somewhat the same ground. The difference in the results I have arrived at to those of Dr. Fleming is doubtless due to the fact that Dr. Fleming experimented with pure materials, while I used the ordinary materials of commerce. But still my results are rather higher than I should have anticipated, and I am led to doubt the accuracy of the Clark cell which I used as a standard of E.M.F. Messrs. Clark-Muirhead have, however, since compared its E.M.F., and state it to be accurate.

The E.M.F. of the Daniell cell is influenced by the density of the solutions, the condition of the plates, by the current the cell is generating and by the temperature.

The Solutions.

As regards the effect of the density of the solutions.—With an amalgamated zinc plate and a copper plate scraped bright, when the cell was generating no current, I obtained the following E.M.F.s:—

Zinc Solution a density of 1.288 = 34° Beaumé.

Density of copper solution.	E.M.F. B. A. volta.	Per cent. difference of E.M.F. from solution of 1.1 density.	Resistance per cubic centim. of solution.
1.15	1.108	+ .3 per cent.	33 ^w
14° Beaumé 1.1	1.105	0	40 ^w
1.07	1.103	— .2 "	53 ^w
1.05	1.102	— .3 "	68 ^w
1.02	1.098	...	...
1.005	1.085	...	...

Copper Solution a density of 1.1 = 14° Beaumé.

Density of zinc solution.	E.M.F. B. A. volta.	Per cent. difference of E.M.F. from solution of 1.288 density.	Resistance per cubic centim. of solution.
1.4	1.096	— 9 per cent.	33 ^w
1.3	1.104	0	29 ^w
1.25	1.108	+ .3 "	29 ^w
1.2	1.112	+ .7 "	31 ^w
1.15	1.117	+ 1.1 "	35 ^w
1.1	1.122	+ 1.6 "	42 ^w
1.05	1.128	+ 2.2 "	68 ^w
1.02	1.135	...	...
1	1.145	...	...
P.O. standard solution = 34° Beaumé } 1.288	1.105	...	29 ^w

From these results the following conclusions may be drawn:—

When the density of the sulphate of zinc solution is more than 1.1, and the density of the sulphate of copper solution is more than 1.05, the increment of E.M.F. per increment of density of solution is constant, and the E.M.F. of the cell may be expressed by either of the following formulæ:—

$$E = 1.118 - .084 (D_z - 1.1) + .054 (D_c - 1.05)$$

$$E = 1.154 - .084 D_z + .054 D_c,$$

where D_z and D_c are the specific gravities of the sulphate of zinc and sulphate of copper solutions respectively.

The resistance as well as the E.M.F. of the cell is affected by changes in the density of the solutions; and from the preceding tables it will be seen that a variation in the density of the sulp. copper solution does not alter the E.M.F. more than $\frac{1}{2}$ per cent., and a variation in the density of the sulp. zinc solution does not alter the E.M.F. more than $2\frac{1}{2}$ per cent. without a considerable alteration in the resistance of the solution. Thus, if a cell were made up with saturated sulp. copper solutions and $\frac{1}{2}$ saturated sulp. zinc solution, its E.M.F. would fall through 3 per cent. without much alteration in the resistance; but any further fall beyond 3 per cent. would be accompanied by a great increase in resistance, owing to the sulp. copper becoming very dilute.

Newly made up solutions, probably owing to their being aerated, always give somewhat higher results (about $\frac{1}{2}$ per cent.) than old solutions.

The Metals.

A freshly electrotyped copper plate gives .2 per cent. more E.M.F. than one only scraped bright. If, however, the electrotyped copper has not been in use for several days it gives about .2 or .3 per cent. lower E.M.F. than a copper plate scraped bright.

A zinc plate scraped bright while dry gives about 1 per cent. lower E.M.F. at first than an amalgamated one, but after several hours' immersion its E.M.F. rises till it is about .5 per cent. lower than the amalgamated zinc. A zinc well scraped while in a wet condition gives .4 per cent. lower E.M.F. than if amalgamated.

A zinc covered with "mud" gives about 1.5 per cent. lower E.M.F. than an amalgamated zinc; when, however, such zincs are generating current, the difference between them is much greater.

Amalgamating the zinc plate adds much to the reliability of the cell.

An amalgamated copper plate gives about $\frac{1}{2}$ per cent. lower E.M.F. than an electrotyped one. But as the amalgamated plate becomes more and more electrotyped its E.M.F. rises nearer to its normal value. Amalgamating the copper plate does not therefore improve the reliability of the cell.

If either of the plates are exposed to the air for some time while in a damp condition, on their replacement in the cell they give a slightly greater E.M.F. (about $\frac{1}{2}$ per cent.) for a few minutes. This increase of E.M.F. is doubtless due to a film of air adhering to the surface of the plate.

Dr. Fleming (in the article before referred to) finds that a scraped copper rod gives .6 per cent. higher E.M.F. than an electrotyped one. He also finds that a thickly oxidised copper plate gives as much as 1.5 per cent. higher E.M.F. than an electrotyped one; and that an amalgamated zinc gives exactly the same E.M.F. as an unamalgamated one.

Effect of the Generation of a Current on the E.M.F.

The production of a current is always accompanied by a fall in the E.M.F. of the cell. This fall varies as a function of the current and is greater as the solution is more dilute. With saturated sulp. copper solution and three-quarters saturated sulp. zinc solution the following effects are obtained:—

When the cell is generating a current of less than one milliampère the E.M.F. falls slowly for more than an hour; but as the current generated becomes greater the fall in the E.M.F. becomes more rapid until with about ten milliampères, the fall only has a duration of about five minutes, and is succeeded by a distinct rise in the E.M.F. The fall becomes more rapid and the succeeding rise in the E.M.F. more noticeable as the current becomes greater, until the cell is shortcircuited,

when the fall occupies only a small fraction of a minute, and is succeeded by a steady rise in the E.M.F. for ten minutes or so.

If the cell is allowed to rest its E.M.F. rises, but it takes several hours to reach its normal value after strong and long continued currents, unless, indeed, the solutions are stirred.

The increments of rise and fall in the E.M.F., of course, occur in geometrical proportion.

There are doubtless several actions taking place in a cell when it generates a current, and its E.M.F. is modified by its history for several hours past. If, for instance, a cell has generated a current and has rested for a time, and then a second current is generated before the cell regains its normal E.M.F., the second fall in the E.M.F. will take place partly from the E.M.F. of the cell when the second current begins, and not from its normal E.M.F.

The cell can only be restored to its normal E.M.F. by well stirring the solutions and allowing it to rest for some time.

It is difficult to give concise figures when the E.M.F. is affected by the current it generates, but generally speaking the E.M.F. would be about $\frac{1}{2}$ per cent. below its normal value if a reading were taken with it generating 1 milliampère, and if the operation did not occupy more than a few minutes. And the E.M.F. would be about 1 per cent. to $1\frac{1}{2}$ per cent. below its normal value if a reading were taken when it was generating 2 to 3 milliampères. If, however, a cell generated a current of 1 milliampère for some time its fall would be more than $\frac{1}{2}$ per cent. But, on the other hand, with considerably stronger currents than 3 milliampères the fall would not vary much from $1\frac{1}{2}$ per cent., and even becomes less, about 1 per cent. when the cell is shortcircuited.

Although the rate at which the E.M.F. falls when the cell generates a current varies as the strength of the current generated, yet there seems to be a tendency of the E.M.F. to reach a certain definite value independent of the strength of the current it generates. This value is a fall of about 1.2 per cent. from its normal E.M.F. But when the cell generates very weak currents its tendency to depolarise itself prevents the E.M.F. falling to this value; and when it generates very strong currents, other actions occurring in the cell make the fall rather less than this amount.

The preceding figures refer only to a cell in which the zinc plate is perfectly clean. With a dirty zinc the fall in the E.M.F. when a current is generated is much greater. It might be as much as 10 per cent. or more when the cell is short-circuited, and be proportionately great with weaker currents.

Effect of Stirring the Solutions.

If the copper solution is stirred there results a momentary increase in the E.M.F., and if the zinc solution is stirred there results a momentary decrease in the E.M.F. These results are greatest with dirty plates, and least with clean or freshly-amalgamated plates; and are, of course, much influenced by the generation of a current.

With a freshly-amalgamated zinc plate, when no current is generated, the effect is usually below $\frac{1}{2}$ per cent., and even when a current has been generated for some time, the effect is not much more than $\frac{1}{2}$ per cent., and the cell regains its normal E.M.F. in two to ten minutes. But with a zinc thickly covered with mud, the effect of stirring the solution is greater, 2 per cent. or more, and the cell takes a proportionately longer time to recover its normal E.M.F.

The Reliability of the Constancy of the Daniell Cell as a Standard of E.M.F.

If not more than 1 milliampère is generated for a few minutes at a time, with reasonable care, the constancy of a Daniell cell may be relied upon to $\frac{1}{2}$ per cent., when the zinc is amalgamated and the solutions

have a definite spec. gravity given them. If, however, the zinc is scraped instead of amalgamated, the cell cannot be relied upon to a greater constancy than $\frac{1}{2}$ per cent.; and when the cell generates strong and long continued currents its constancy would be decreased; but, in any case, it should be relied upon to $1\frac{1}{2}$ per cent. and 2 per cent. with amalgamated and unamalgamated zincs, respectively. The Daniell cell cannot be relied upon to the preceding accuracies, unless it is made up each time it is used.

I believe, however, that a carefully prepared Fleming cell, if it generates no current, may be relied upon to an accuracy of quite a tenth per cent. Unlike the Clark cell, the Fleming cell is not easily transportable. It has, however, the advantage over the Clark cell that its E.M.F. is not so much affected by any current that may be accidentally sent through it.

Bichromate Cell.

A newly made up bichromate of potash cell gives a normal E.M.F. of 2.09 B.A. volts. When a current is generated, the first fall in the E.M.F. is followed by a distinct rise, after which the E.M.F. remains steady until the current ceases, when the E.M.F. again rises until it passes its normal value, to which it then returns. The maximum E.M.F. after generating a strong current is 2.145 B.A. volts. As, however, the solutions become older, the fall in the E.M.F. when a current is generated becomes greater, and the rise in the E.M.F. on the cessation of the current is less marked, until it does not pass beyond its normal value.

The time occupied by the cell in recovering its normal E.M.F. after it has generated a current varies as the strength and duration of the current, and the age of the solutions. It varies from a fraction of a minute with new solutions, to an hour or more with old solutions, after strong and long-continued currents.

The normal E.M.F. of an old, but workable, bichromate cell is 2 to 3 per cent. less than that of a newly made up cell. When, however, the cells generate current, the difference between them becomes greater as the current becomes stronger.

W. MOON.

THE BARMEN CENTRAL STATION.

THE year 1888 witnessed the introduction of the electric light by central stations in a number of German towns, amongst which Barmen is conspicuous, not only for the quality and soundness of the work done and for the arrangements, which are peculiar in many respects, but also on account of the special difficulties which the hilly character of the country presents to all underground work (there are steep hills on both sides of the river Wupper, with numerous crossings of that river and the "mill creek").

The general installation (buildings, steam engines, dynamos, accumulators, &c.), has been furnished by the firm of Friecker & Co., of Cologne (which has in the meantime been amalgamated with the firm of S. Schuckert, of Nuremberg). The cables have been manufactured and laid by the firm of Felten and Guilleaume, of Mülheim-on-Rhine.

The plant is at present designed to furnish the current to 2,000 glow lamps of 16 C.P. each, by means of two steam engines and four dynamos, in combined action with 272 accumulators. The buildings are, however, so arranged as to admit of an extension to 6,000 lamps.

Having regard to the general disposition of the streets of the town, it was considered advisable to execute the cable system on the three-wire principle. It consists of (a) the main cables or feeders carrying the current from the engine house to conveniently situated points at which it is divided by means of "main cable boxes." The positive and negative main

cables are provided with one, the neutral cables with two insulated tension wires enclosed under the same covering (see figs. 1 and 2). (b) The distributing cables which are connected to the before-mentioned main cable boxes by means of lead cut-outs, and which at their crossings are connected among themselves by means of lead cut-outs in other boxes, called "distributing cable boxes." (c) The house connection cables (see figs. 3 and 4). Some of these are connected by lead cut-outs direct to the cable boxes; the others ramify from the distributing cables. The main cables, positive, negative, and neutral are 36 in number, with sections of 190, 170, 120, 110, 90, 85, 60, 55, and 50 square millimetres, forming a total length of 22,000 metres. There are 204 distributing cables, with sections of 110, 80, 70, 50, 40, and 30 square millimetres, forming a total length of 28,000 metres, and many kilometres of house connection cables with sections of 30, 20, 15, and 10 square millimetres.

The total weight of all the cables employed is upwards of 200 tons.

The longest distances of the system are :—

1,045 metres	to east of engine house.
1,250 "	west "
890 "	south "

The cables are all carefully marked so as to be easily distinguishable in case of repairs later on. They are insulated with Felton and Guillaume's impregnated fibre, and provided with a double lead covering against

construction of the current distributing circles. The brick foundations for the same are provided with a water sink-pit, and have to carry the manhole cover in the street plane. They are so arranged that at any time additional cables can be introduced without having to break up or to make alterations in the masonry.

The whole work of manufacturing and laying the cables took but a few months, while at the same time the firm of Felten and Guillaume had to make and supply all the cables required for the central stations at Hamburg, Bremen, Lübeck, &c.

They are different from those of the Barmen installation, in that they are constructed on the ordinary parallel system; among the cables used in them there are sections of upwards of 600 square millimetres.

The total lengths of cable used in these various installations are as follows :—Barmen, 53,000 metres; Hamburg, 49,000 metres; Bremen, 21,000 metres; Lübeck, 21,000 metres.

All of these are lead covered, but in Hamburg, Bremen, and Lübeck the majority of the cables are not sheathed with ribbon iron (see figs. 5 and 6), but laid in iron troughs with strong iron covers. Also in Hamburg the tension wires are not laid up in the main cables, separate small cables being used.

The experience gained by several years' use of Messrs. Felten and Guillaume's impregnated fibre insulated and lead covered cables speaks greatly in their favour. It may be mentioned that Messrs. Felten and Guillaume also produce by the same process telephone

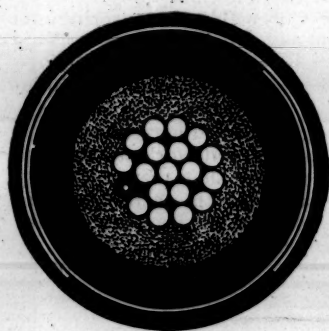


FIG. 1.

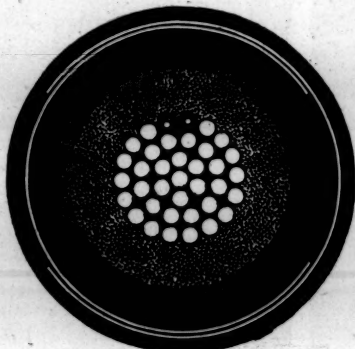


FIG. 2.

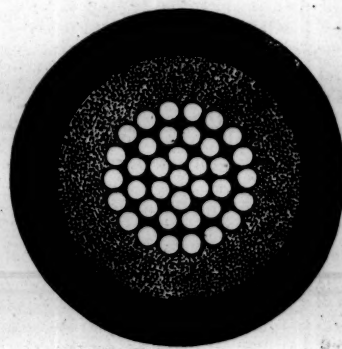


FIG. 5.

moisture, as well as a double iron taping against mechanical damage. All cables have been tested under water in the factory at Mülheim-on-Rhine both with regard to conductivity and insulation resistance. They have also been kept under electrical control throughout the operation of laying. After completion the entire cable system, including all cable boxes and house connections, was tested from the central station by means of a delicate mirror galvanometer with very favourable results, exceeding by far the guaranteed figures.



FIG. 3.

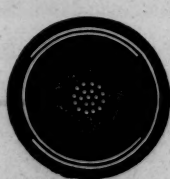


FIG. 4.

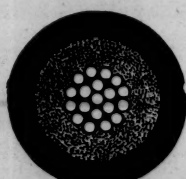


FIG. 6.

For the purposes of distribution and equalisation of pressure there are in the system 41 cable boxes, viz. : 12 main cable boxes and 29 distributing cable boxes. They have been specially constructed for the purpose by Messrs. Felten and Guillaume according to latest improvements, and are interesting, not only for the manner in which they are rendered watertight at the places where the cables enter, but also for the peculiar

as well as telegraph cables, both subterranean and aerial, of which a total of upwards of 1,500 kilometres have left their works up to the present, and are in use in all parts of the world.

Lighthouse Illuminants.—The London correspondent of the *Glasgow Herald* says :—I learn that a start is at length about to be made with the new inquiry on the question of Lighthouse Illuminants. Prof. Stokes, the President of the Royal Society, who undertook, at the request of the President of the Board of Trade, and with the acquiescence of Mr. J. R. Wigham, to preside at the inquiry, has nominated as his colleagues on the committee Sir William Grove, one of the Fellows of the Society, and Lord Rayleigh, the secretary. In the hands of these eminent experts no fear need be entertained as to either the thoroughness or the impartiality which will mark the investigation into the relative merits of oil, gas, and electricity. The functions of the committee are strictly confined to deciding whether "the conclusions of the Trinity House, as set forth in their reports on lighthouse illuminants, are justified by the records of the experiments contained therein." It is understood that the committee are at full liberty to receive such evidence and to take such steps as they may think desirable to enable them to decide upon the points at issue, but whether this will lead to further experiments being instituted remains to be seen.

ALTERNATING CURRENT DYNAMOS.

In our issue of May 3rd, we published a letter from Messrs. Elwell-Parker, Limited, respecting their alternating current dynamo; we now reproduce the photo-

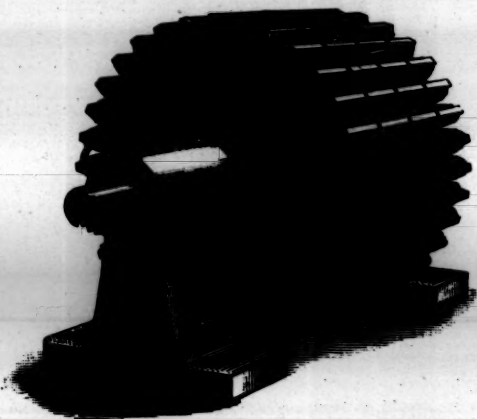


FIG. 4.

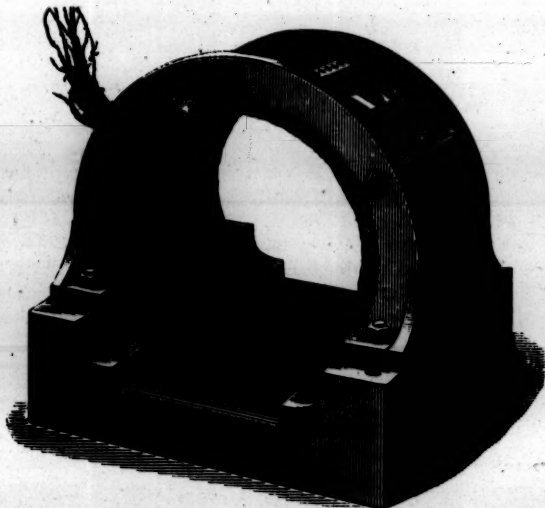


FIG. 2.



FIG. 3.

graphs of the machine built by them to their patent specification, No. 3,710, in 1882. Fig. 1 is the complete machine. Figs. 2 and 3 are two armatures, both with

iron cores; in one case the whole, and in the other only half of the surface of armature is covered by the conductors. The diameter of armature is 16 inches, and the length 12 inches. The ends of the wire are brought out together, so that they can be connected in series, parallel, or series parallel as required for experimental purposes. Fig. 4 shows the magnets which are the revolving portion of the machine, the number of poles being 32, and the speed 1,000 revolutions per minute,

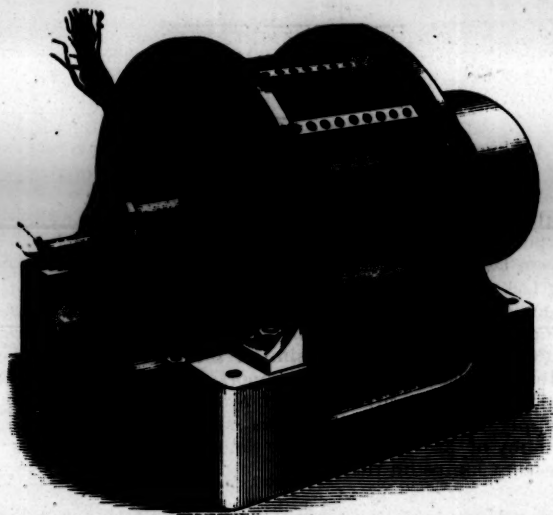


FIG. 1.

thus giving 32,000 alternations. Machines built to this design gave most satisfactory and efficient results compared with anything then in the market.

When the transformer system for central station lighting was introduced, Messrs. Elwell-Parker gave their attention to improve the details and construction of their early machine. Fig. 5 represents the design

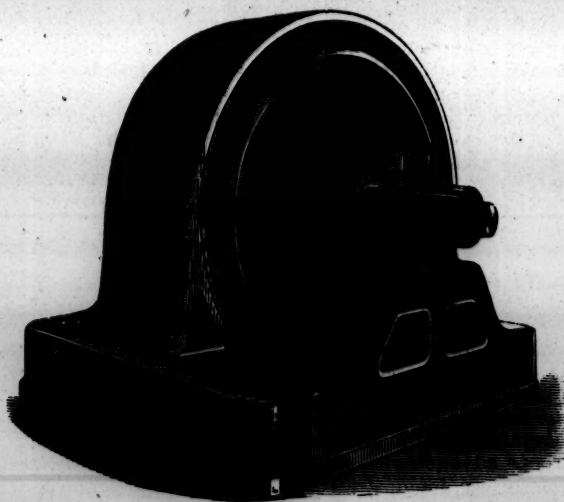


FIG. 5.

now adopted by them, which we have previously alluded to in connection with the central station of the House-to-House Company at West Brömpton.

In this case revolving magnets and a stationary armature are still employed, but the number of poles has been very considerably reduced when compared with the early machines, the standard now adopted for the number of alternations being 12,000 per minute. The section of iron in the armature core has been increased, and the method of insulating and holding the conductors improved. The conductors are, in the first place, insulated

from the laminated core, and this is again insulated from the frame of the machine. In both magnetic and electrical features the machines now built are similar to those patented in 1882 by Messrs. Elwell-Parker, whose patent, it is interesting to note, also clearly describes the alternating current machine now being so successfully built by the Westinghouse Company in America.

Messrs. Ganz & Co. have lately been laying claim to the type of machine illustrated and described above, and we therefore publish the above facts.

NOTES.

Proposed Electric Lighting in Leeds.—The question of lighting the central part of Leeds by electricity came before the committee of the Corporation dealing with the subject on Thursday last week. The Borough Engineer reported that he had received estimates and particulars from two firms for the lighting of the central portion of the town. A discussion ensued as to the number of persons who were likely to take advantage of illumination by means of the electric light, the probable cost to such persons, and other similar matters. Finally Mr. Hewson was instructed to report to a future meeting upon the comparative cost of systems based upon the supply of light, in the area specified, through the agency of arc lamps on the one hand and of incandescent lamps on the other.

Vienna and the Electric Light.—The *Financial News* says, Vienna seems as likely to get electric light now as London is to get water gas. An international company has been started in the former town for the purpose of supplying the streets and private houses with the light at the least possible cost. The capital of the concern is five millions of florins, and the issue of the shares will be made by the Union Bank of Vienna.

Ship Lighting.—Last week the twin-screw steamer *Modjeska*, recently launched by Messrs. Napier, Shanks and Bell, went on her trial trip on the Clyde with a highly satisfactory result. She has been specially designed and built to the order of the Hamilton Steamboat Company for their passenger service on Lake Ontario. Electric light is fitted throughout the vessel, and this will enable passengers to enjoy the evening trips which are regarded as a special feature in the American lake service. The installation has been fitted up by Messrs. Paterson and Cooper, of Glasgow and London.

The Electric Light in Warfare.—On Friday evening last Sir L. Smyth, who has taken over the command of the Southern District, had all the troops on the Gosport side under arms at a very unexpected hour to resist an enemy supposed to have landed at Southampton and advancing on the forts protecting the southern side of the harbour. The main object in view was to test the advantages of the electric light in land defence against troops advancing on entrenchments, and its efficiency was amply demonstrated.

Electric Lighting at Southampton.—At the last meeting of the Southampton Town Council it was stated that a letter had been received from the Local Government Board, acknowledging an application to borrow £4,440 for electric lighting purposes, and stating, for the information of the Council, that the Board had determined to submit a case to the law officers of the Crown as to whether local authorities were empowered, under Section 161 of the Public Health Act, 1875, to manufacture electricity. The Board had, therefore, deferred the further consideration of the application.

Electric Lighting at Verviers.—This town has made great progress in the adoption of the electric light and it will not be long before all the large works have installations. There has just been completed the installation of the plant for lighting the large spinning and dyeing works of Messrs. Petit and Follet. There will be 70 arc lamps of 600 C.P., 3 arc lamps of 1,400 C.P. and 100 glow lamps.

Municipal Electric Light Station at Königsberg.—It has been decided to establish a central electric light station at Königsberg at the expense of the town. The estimated cost is £35,000.

Electric Lighting at the Palais de l'Elysée.—The electric light has been permanently installed here. Until the present time the electric light has only been used at the Palace on the occasion of official balls, and was obtained by means of accumulators which had to be brought up and carted away at a comparatively great cost. In order not to have the trouble and risks attending the use of steam engines, President Carnot has decided to adopt the transformer system, and the central station at the Palais Royal has been entrusted with the carrying out of the work. A special alternating current dynamo has been erected at the station, and is supplying the current to the transformers through two cables of 7 millimetres diameter.

Portsmouth and the Electric Light.—On Tuesday a number of representative men from Portsmouth visited Brighton and Eastbourne with the view of making enquiries as to the working of the electric light system in those towns. At Eastbourne the visitors were hospitably entertained by the Mayor, in proposing whose health the Clerk of the Peace at Portsmouth (Mr. R. W. Ford) said that Eastbourne had set an example to much older towns in the matter of electric lighting. In the course of a few days a meeting was to be held at Portsmouth to consider the question of electric lighting, as it was considered that the new illuminant might be applied for the benefit of the town and also for the good of those who would use it. In response the Mayor said that they had increased their number of lights in Eastbourne to 2,221. The new system was rapidly gaining ground. The company received about £480 a year from the Eastbourne Corporation for the supply of the new light, and, in addition, they had a great number of private subscribers. The Electric Light Company was in earnest, and was determined to succeed. They meant to make the electric light a financial success, and next year to pay a handsome dividend. Subsequently the deputation proceeded to Brighton and made a thorough inspection of the electric lighting installation there.

A Central Station in Glasgow.—It is only the other day that a supply of electricity was for the first time offered to the public of Glasgow, through a small but influential company, under the name of Muir, Mavor and Coulson, Limited, who have laid down plant which will enable them not only to carry out their contract with the Town Council, but to supply consumers in the city with light and power. The new works have just been fitted up, and the company has at present facilities for supplying 3,500 incandescent lamps of 8 candle-power, and by next winter they expect to have doubled the power of production. The price of the current is 8d. per 1,000 watt-hours, a sliding scale of discounts being allowed, according to the quantity consumed. Making this allowance, it is estimated that the cost will be about double that of gas.

Use of Telephones in Hospitals.—The *Medical Press* says there is a talk of applying telephones to the infectious wards of the French hospitals, so as to enable the sick people isolated in their contagious sufferings to have the comfort of hearing their relatives' voices without any risk of conveying infection by an interview.

The Telephone in Railway Operations.—The telephone has been applied to a new purpose on the railway between St. Valerie-sur-Somme and Cayeux, namely, to enable the guard of a train broken down or delayed by any accident between two stations to call to the nearest station for assistance.

Telephonic Extension.—At a meeting of Kincardineshire Road Board last week, authority was given to the National Telephone Company to erect telephone poles and wires between Lower North Water Bridge and Aberdeen, in connection with the formation of a trunk line from Edinburgh and Glasgow to Aberdeen. Authority has also been given by the Road Trustees for the erection of a line from Greenock to Wemyss Bay and Largs.

Submarine Telegraphing.—In the House of Commons, on the 8th inst., Mr. Jackson moved that the contract dated the 12th day of April, 1889, for the construction of a submarine telegraph line from Halifax, Nova Scotia, to the Island of Bermuda, be approved. The cable would be very important from a military and naval point of view, and also for Colonial purposes, and it was the idea to carry it beyond Bermuda, to the West Indies, so as to make it of greater commercial value. The subsidy of £8,100 to be given to the International Cable Company for performing the contract would only be payable from the time that the cable was in working order. The subsidy was a reasonable one, and he trusted the contract would be approved. Dr. Cameron proposed as an amendment that, in the opinion of the House, the telegraphic communication in question would be better and more economically secured if the cable were owned and controlled by the Government. After some discussion the amendment was rejected, and the motion agreed to. This matter was touched upon in our last issue.

Telegraphy in Madagascar.—The new telegraph lines in this island have been almost entirely destroyed by recent floods.

Postal Telegraph Facilities.—At present a number of men from the Government department are engaged putting up poles from Skelmorlie to Largs for the purpose of running a wire direct from Millport to Glasgow, as the present wire connecting Largs and Millport with the city is quite inadequate for the summer requirements. Morse sounders will take the places of the single needles now used.

The Submarine Telegraph Company's Cables.—The *Daily News* says the total sum paid for the Submarine Telegraph Company's property is £81,313. £14,150 has been received from France and Belgium, being one-half share of the property in the cables. The balance, a trifle over £67,000, represents the British interest in the concern, and includes the purchase of buildings, cable, ship stores, and offices.

Lubricants.—Messrs. W. H. Willcox and Co., of Southwark, who devote special attention to the preparation of oils for lubricating purposes, have just issued a new price list in which the properties of different lubricants are pointed out and the purposes indicated for which they are particularly designed. A special dynamo oil is sent out by this firm, and has been used for years past in some of the largest electrical installations in this country and America.

The Thomson-Houston System in Paris.—We learn from Paris that the representative of the Thomson-Houston Company in that city has secured a large proportion of the street lighting, and that the arc lamps on this famous system were started for the first time on Saturday night in the Place de la Concorde. He has also in hand large contracts for incandescent lighting, which will be carried out on the Thomson-Houston alternating system. The arc lamps are the first public electric lights that have been seen in Paris for many years.

Horseshoeing by Electricity.—A novel use of electricity is about to be tested in sharpening the shoes of car horses in icy weather without removing them from the stable. This important application of electricity is being made by the Baxter Electric Manufacturing Company, of Baltimore, and is likely to prove one of the most useful applications yet made, and will especially commend itself to the Society for the Prevention of Cruelty to Animals.

The Electrical Exhibition in Bingley Hall.—Preparations for the Electrical and Industrial Exhibition, which is to be opened in Bingley Hall in August next, are being pushed forward with most satisfactory rapidity, and already nearly the whole of the space available for exhibitors has been let by the committee. In the electrical department most of the best known firms of electrical engineers and manufacturers of electric appliances will be represented, among them the Edison and Swan Electric Light Company, the Anglo-American Electric Light Company, Messrs. Woodhouse and Rawson, Limited, Messrs. Elwell-Parker, Limited, Messrs. Laing, Wharton and Down, Limited, the Gùlcher Electric Light Company, Limited, Messrs. Shippey Bros. Limited, Messrs. Ernest Scott & Co., the Planet Electrical Engineering Company, Messrs. Fowler, Lancaster & Co., the Julien Company, Julius Sax, and the Acme Company. The exhibitors in the steam engine section will include such well-known firms as Messrs. Robey & Co., Messrs. Ruston and Proctor, Messrs. Galloway, and Messrs. Greenwood and Batley.

Overhead Wires.—The secretary of the London Chamber of Commerce received a letter from Sir Thomas Blomefield, dated April 12th, asking to be informed later on when a deputation from the Chamber on overhead wires would like to wait upon the President, and stating, in the meantime, that a copy of the proposed regulations would be forwarded as soon as they were printed. A copy of this letter was forwarded to the members of the committee and to others interested in the matter. On the 5th inst. it was ascertained from Captain Cardew that the regulations had for some time been in the hands of the Post Office, and that their sanction was the only step that remained. Mr. Preece writes in reply to an enquiry on the subject that the regulations are not yet through their solicitor's hands.

English Representatives Abroad.—A letter has been received from an engineer in Portugal requesting the Electrical Trades Section of the London Chamber of Commerce to consider the following matter. There are several English agents with no technical knowledge. They recommend machinery quite inadequate for the work required. An installation under the writer's notice is a complete and humiliating failure from this reason. Local salesmen should know what can and what cannot be done, and how to do it. He suggests:—1. Some organised steps might be taken to supply technical information to well-established English engineering selling firms abroad. 2. That manufacturers might combine to decline to supply price lists or to give trade terms to foreign or export houses without some proof that the information or the goods are going into competent hands.

The Royal Society.—The following paper was down for reading yesterday:—Prof. E. Hull, F.R.S., "On a Possible Geological Origin of Terrestrial Magnetism."

Standardizing.—The committee of the Electrical Section of the London Chamber of Commerce recently met the joint committee of the Institution of Electrical Engineers, and it was arranged that an estimate for a laboratory and the requisite plant should be prepared. The committee is now waiting for this estimate, which will then be considered by the joint committee, who propose to ask for an interview with Lord Salisbury.

Passenger Telfer Lines.—We understand that the United Electrical Engineering Company, Limited, has just closed a contract with the Mines and General Telfer Company, Limited, for the equipment of a telfer line to convey visitors from the Wood Green Station up the hill to the Alexandra Palace. The Palace now seems to have entered upon a prosperous era, and it is confidently anticipated that the coming season will be a specially successful one. The simplicity and economy of electrical traction is likely to cause very great extensions in the equipment of light railways and tramway lines between towns and outlying suburbs and villages which are not yet provided with carrying accommodation, for even in the United Kingdom, where transport requirements may be said to be much better provided for than in other countries, a considerable amount remains to be done. As has been pointed out by Mr. A. R. Bennett, in respect to Scotland it would certainly not pay to open up most of these districts by means of the ordinary steam railway, even if single tracks and light engines were adopted; but they might profitably be exploited by means of telfer lines or electric tramways, laid either on the public roads or close beside them. In the case of the colonies and abroad, of course, the field is enormous, and it would seem that the telfer system may be a powerful factor in leading to the development of countries which either do not possess capital enough to build railways or even to make common roads, or have not sufficient traffic to justify a large expenditure. We wish every success to the Alexandra Palace scheme.

Induction Coils.—The true explanation of the question asked by a correspondent seems to be as follows:—At the moment the two parts of the contact breaker commence to separate, the extra current tends to continue to flow by leaping across the air space between the contacts, and thus to keep up the magnetism of the core. When a condenser is connected to the contact breaker, at the moment of the separation of the parts of the latter, the extra current has an easier path into the condenser than across the air space, hence it flows into the condenser; but the latter soon becomes charged and stops the flow, and the current would then tend to jump across the air space; but by the time the condenser has become charged, the two parts of the contact breaker become so far separated that this jumping across cannot take place (for it should be recollected that a comparatively high potential will not flow across even a small air space if the continuity be once interrupted), hence the stoppage of the flow of the extra current continues, and the magnetism of the iron core being no longer kept up by the flow runs down rapidly and produces a powerful effect on the secondary. When the contact breaker closes, the condenser, of course, becomes discharged.

Storage Batteries for Street Cars.—The last car, No. 7, which the Julien Company has put into actual passenger service in New York, is regularly running its 57½ miles daily. The saving claimed on each car per year, as compared with horse traction, is \$2,720, and the net earnings will more than pay the entire cost of the car and its equipment at the end of the first year. Thirty of these cars are now being constructed, and there is every indication that the Julien Company will bring accumulators to the fore for electric haulage.

Atlantic Cable Broken.—The Telegraph Construction and Maintenance Company's steamer *Britannia* left London some days ago with 40 miles of cable to replace the Direct United States Company's cable, which has broken 460 miles from Halifax, on the Newfoundland banks, in 60 fathoms of water. The company anticipates that the repairing of the cable will be an easy matter. The *Britannia* was despatched within 24 hours after the receipt of orders with a full staff of electricians.

Lightning Conductors.—Our readers, says a Belgian contemporary, will remember the accident which, in July last, was the cause of the fire at Brussels Hôtel de Ville. At the base of the tower a piece of iron near a lightning conductor received a discharge of electricity, from which arose a shower of sparks which set on fire the battens which had become dry from long use. The firemen, who arrived immediately, were fortunately able to prevent a catastrophe. Since that time, we learn, the heads of the technical departments have undertaken a general revision of the protection of the monument. The lightning conductors of the Hôtel de Ville form a vast network, disposed according to the Melsens' system, and form a Faraday frame, which entirely protects the building. There are six descents to the ground, the whole of the wires from the roofs bearing aigrettes. Similar works have been carried out at the Théâtre Hamand, and are in course of erection at the Théâtre de la Monnaie and other buildings.

Insulting the President of the French Republic by Telephone.—We take the following from *Gil Blas*:—A very curious incident, and which is still unknown to the public, occurred at the Elysée on the opening day of the exhibition. M. Carnot was speaking to his military household, when the telephone bell suddenly rang. General Brugère answered the call, "Hallo!" "M. Carnot?" answered a voice. "What do you want with him?" "I want to speak to him personally." "Wait at the apparatus," and the General went to inform the President. When M. Carnot placed the horns to his ears, he at first heard a confused noise, then a series of insults. "You are a wretch, a fool, &c.," said the man who was communicating with him. The joke was in bad taste. M. Brugère informed the Prefecture of Police, and an enquiry was begun. It was long before "the insulter by telephone" was found to be one of the principal employés of a large commercial house, who was well known for his Boulangist ideas. It was found, however, that the Court could do nothing with him, insult by telephone not being looked upon as a public one.

Electricity in Brussels.—A short time since we gave some particulars as to the organisation of a service for the distribution of electricity in Brussels. Several important foreign companies took the programme into consideration; and, on its side, the city authorities ordered its specialists to examine a project for the establishment of an electrical works in the centre of Brussels, a central station which would supply current to 10,000 16-candle lamps. We also understand that a cable is to be at once laid down between the Théâtre de la Monnaie and the Maison du Roi, in the cellars of which will be placed the accumulators used for the electric lighting of the stage. At the Monnaie, more powerful batteries will replace these accumulators, which are looked upon as not being sufficient for the future. Within a measurable period of time from now, too, the central bureau of the Brussels electrical timing will be transferred to the Rue de l'Etuve, whence the electrical and lighting services are worked. This removal is brought about by a transference of the police office, and of the telegraphic and telephonic services, annexed to that office.

The City of Brussels will receive, until 1st June next, tenders for the establishment and working of a system of electric distribution by underground mains. Applications are to be made to the Service d'Electricité, Rue de l'Etuve, 11A, Brussels.

Society of Chemical Industry—Glasgow and Scottish Section.—The seventh meeting of the sixth session was held last week. A paper on "The Vulcanisation of India rubber, with special reference to the use of chloride of sulphur," was read by Mr. C. A. Fawcett. Mr. R. Irvine read a note on the condensation of carbon particles in smoke under the influence of an electric current, and exhibited the phenomenon by an experiment.

A Submarine Boat Eight Hours Under Water.—Some interesting experiments have recently taken place at Cherbourg, the following details of which we take from *Dix-Neuvième Siècle*. The other day two sailors belonging to our Navy were from 9 in the morning till 5 in the evening under water at a depth of 10 metres without experiencing the least inconvenience. Our readers have already divined that it was on board the submarine torpedo boat *Goubet* that this unprecedented event took place. The commission of examination were enabled by telephone, minute by minute, to receive the impressions of the two men. When they came to the surface at 10 minutes past 5, they were quite fresh, and ready to go down again. Not a drop of water had entered the boat, and there was not the faintest odour perceptible. It now remains to be demonstrated whether the vessel can be navigated under the water as on the surface, either by electricity or by means of oars worked from the interior, which the inventor has placed on the boat's sides. This boat has been named the "fish boat" by the French press.

Crompton-Swinburne Alternating Current Dynamo.—A correspondent wishes to know the results of the trial with this dynamo, which was announced to take place some months ago. Perhaps one of the inventors may probably deign to satisfy the searcher after knowledge.

The Westinghouse Company.—We learn from the *Bulletin International de l'Electricité* that the Westinghouse Company proposes to establish works in Paris for the construction of all the plant required in central stations, such as engines, dynamos, transformers and lamps. The capital of the new company to work the concern is fixed at £1,000,000, and it is proposed to make an offer for lighting the Parc Monceau, the Champs-Élysées and part of the left bank of the river.

Medical Electricity.—It is announced in a French contemporary that M. Oudin has modified the Wilmhurst machine so that it can be successfully used for medical purposes.

Electric Traction in Naples.—Application has been made to the Naples Municipality for permission to construct five electrical tramway lines of a total length of 14.7 kilometres.

Discussions on Institution of Electrical Engineers' Papers.—The council has made arrangements for furnishing the technical press with an abstract of the discussions at the general meetings. Although this departure has only been made for the present year the council hopes to be able to continue it in the future.

Spain.—The towns of Costova, Arpeilla, and Azcontia, which have water-power at their command, are installing the electric light.

Electricity v. Gas.—The municipal council of Louhans has decided to substitute for the public gas lights electric lighting from 1st May, 1890.

Engineering Students' Club.—At a meeting of this club, held at the Durham College of Science on Thursday evening, last week, a paper was read by Mr. V. Newitt on "Electricity, as applied to workshops."

The Institution of Electrical Engineers.—The ordinary general meeting will take place on Thursday, May 23rd, 1889, at 8 p.m., when a paper, "On Alternate Current Working," by W. M. Mordey, member, will be read.

Submarine Cables.—The total length of the submarine cables at present in use is given by an Austrian paper at 113,031 miles. Of this length, 102,531 miles belong to various cable companies, and 10,500 miles are Government property.

London Central Subway.—The Bill for the construction of an electrical subway railway between Holborn Circus and Piccadilly was further considered before the House of Commons Select Committee on Monday. Evidence for the promoters was continued, Mr. Harrison Hayter, C.E., in the course of his examination, stating that he was of opinion that the subway could be constructed well within the estimates. Mr. Chatterton, a surveyor, was examined as to the practicability of dealing with the various underground sewer pipes, &c.

On Tuesday the evidence of engineers in support of the scheme was proceeded with. The engineer (Mr. Knight) said that the electrical motors would be used at each end of the train, the one pulling and the other pushing. They would be able to go up to 20 miles an hour in speed, but the average would be 12. Mr. R. E. Crompton, Dr. Hopkinson, and Sir William Thomson gave evidence in support of the scheme being practicable in their opinion. Mr. W. H. Preece, the electrician to the Post Office, said that the current in the mains would not interfere with the telephonic and telegraph wires, and the galleries proposed for them would be ample and convenient. Evidence was given as to the working cost per train mile being about 1s. 6d., and that an additional 1s. 6d. earned would pay a 5 per cent. dividend. Mr. Pope, Q.C., for the London County Council, said that evidence to the contrary would be called.

Telegraphic Extensions—Coming Contracts.—We hear from the West Indies that important extensions of the telegraphic communications of San Domingo are contemplated during the present year. No tenders have yet been invited or official announcements made, but when they are there is no reason why a large proportion of the orders should not be obtained by British contractors.

Electric Tramways in Towns.—The subject of electric tramways in Birmingham was dealt with in a paper read by Mr. T. Arnall to the members of the Mason College Engineering Society. Mr. Arnall said that for Birmingham, at least, the system of overhead conductors was impracticable. The underground conductor was more practicable; but, on the whole, he considered that the secondary battery or accumulator system was the best.

The West Indies.—An important electric light station is to be shortly completed at Havana, and other towns in Cuba are also adopting the new light.

Dabbling with Electricity.—An extraordinary case of accidental death by electricity is reported from America. Mr. Vincent, a well-known citizen, and a brother of Bishop Vincent, of the Methodist Church, being in a low state of health, conceived the idea of treating himself by electricity. Instead, however, of procuring the ordinary medical electrical appliances, he rashly interfered with the mains of one of the electric light and power companies, and received a shock which killed him as quickly and as surely as lightning.—*Pall Mall Gazette*.

Electrical Touring.—At the Kent County Council, on Tuesday, Mr. Links, of Kent House, Sydenham, made application for permission to run a wagonette propelled by stored electricity over the roads in Kent. The applicant stated the vehicle would not differ in appearance from carriages drawn by horses, and it would weigh half a ton. He would take out an excise license for the vehicle. The Clerk to the Council stated that the vehicle would have to be licensed under the Locomotives Act, and the Council could not prohibit its use. By the provisions of the Locomotives Act the licensee would be required to hire a man to walk in front of the carriage with a red flag. He then *can* "travel" about three miles an hour, a leisurely mode of progression which would enable him to examine the country thoroughly. If he should "travel" at a greater speed he becomes amenable to the law and liable to heavy penalties.

Tramway Traction.—An American tramway journal has issued several hundred inquiries on the subject of motive power, and of the replies received only 18 per cent. were to the effect that no change from horse traction was contemplated. There were 15½ per cent. who did not reply, and may therefore be included in the same category, and 16 per cent. were waiting for further developments of mechanical traction. Of the others 16½ per cent. preferred mechanical to electrical traction, and 34 per cent. went in for electricity. This evidence, collected not by anyone interested in electrical engineering, is decidedly favourable to that branch of science, and shows the tendency of opinion as far as the United States are concerned.

The Electric Light in Düsseldorf.—There are now in Düsseldorf and the neighbourhood 26 electric light installations with 44 dynamos. Of these installations 14 are in factories, 4 in restaurants, 2 in printing offices and 3 in other works; and in addition the Bergisch-Märkische Railway Station, the Mechanics' Institute, and the Bergisch-Märkische Bank are electrically lighted. The 44 dynamos supply current to 240 arc lamps of 186,950 C.P., and are driven by steam and gas engines of a total H.P. of 520. Little has been done here in shop lighting, only two shops being supplied. An attempt has been made to induce householders to subscribe for a central station, but without success.

NEW COMPANIES REGISTERED.

Keswick Electric Light Company, Limited.—Capital £5,000 in £1 shares. Object: To carry on at Keswick, Cumberland, and such other places as may be determined, the business of an electric light and power company in all branches. Signatories (with 1 share each): R. Dykes Marshall, J. J. Spelding, P. Harrigan, Alex. Knight, M.D., Wm. Wilson, J. Broatch, all resident at Keswick; W. P. J. Fawcett, C.E., Chester. Registered 1st inst., without articles of association, by Messrs. Waterlow Bros. and Layton, Limited, of Birchin Lane, Cornhill, as agents for Messrs. J. Broatch and Gandy, of Keswick.

Crompton Howell Electrical Storage Company, Limited.—Capital £19,600, divided into six founders' shares of £100 each, and 19,000 ordinary shares of £1 each. Objects: To carry on the manufacture and sale of secondary batteries, and in particular to take over the business of the Crompton Howell Electrical Storage Company. Signatories (who each subscribe for one ordinary share): *J. F. Albright, C.E., Mansion House Buildings; *J. C. Howell, Llanelly, electrical engineer; Hy. Lawrence, 29, Grove Hill Road, Denmark Hill; G. E. Hartmans, 28, Hartington Road, Ealing, electrical engineer; H. J. Dowling, 4, Queen Victoria Street, electrical engineer; F. R. Reeves, Springfield, Potter's Bar; L. J. Maton, 21, Cannon Street, E.C. The first directors are the signatories denoted by an asterisk, with Rookes Evelyn Bell Crompton, W. A. Albright, and Arthur Albright; qualification, £500 in shares; remuneration, £50 per annum each. The ordinary shares will be entitled to a preferential dividend of 15 per cent. per annum, and the surplus profits are to be divided equally between the holders of the ordinary and founders' shares. Registered office, Mansion House Buildings, Queen Victoria Street. Registered 3rd inst., by Mackrell, Maton and Godlee, 21, Cannon Street.

Medical Battery Company, Limited.—Capital £100,000 in £5 shares. Objects: To take over the business of the existing company of the same title, upon terms of an agreement between that company and Mr. C. B. Harness of the one part and Hy. Charles Risborough as trustee for the new company, of the other

part. To provide for and carry out the treatment of diseases by means of galvanic, electric, and magnetic appliances, batteries, baths, and other apparatus, and by means of massage, hydrotherapie, inhalation, and mechanical exercise (Dr. Zander's, or any other system). Signatories (with 1 share each): Major C. G. Elern, Crewkerne, Somerset; W. E. de Lorne, 34, Sidney Road, Stockwell; Cornelius Bennett Harness, Potter's Bar, medical electrician; E. S. Crick, Montserrat Road, Putney; A. Fleet, 39, Hatton Garden; G. T. Wells, Crewkerne; Robt. Carter Moffatt, Northumberland Park, professor of chemistry. The present directors of the old company are appointed directors of the new company, and, including the managing director, are to be paid 5 per cent. on the net divided profits for the year, together with all reasonable out of pocket expenses incurred in attending meetings, if sanctioned by the directors.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Medical Battery Company, Limited.—At a meeting of this company, held on the 18th ult., at 52, Oxford Street, special resolutions were passed authorising the voluntary winding up of the company, and appointing Mr. Harness as liquidator. The resolutions were confirmed on the 4th inst., and were duly filed on the 6th inst., and on the same date the liquidator filed his consent to the registration of a new company with the same title. The last return of the old company is made up to the 18th August, 1888. The nominal capital is given as £100,000, in £5 shares, the whole being taken up; £94,000 being considered as paid upon 18,800 shares, the remaining 1,200 shares being fully paid up.

Electrical Power Storage Company, Limited.—The annual return of this company, made up to the 24th ult., was filed on the 1st inst. The nominal capital is £200,000, in £1 shares. 149,450 shares have been issued, and the full amount has been called and paid thereon.

Montevideo Telephone Company, Limited.—By a resolution of 27th March, the capital of this company was increased by the addition thereto of £40,000, divided into 8,000 shares of £5 each, beyond the registered capital of £180,000. Notice of this increase was filed on the 2nd ult.

An agreement of 20th March, filed 2nd ult., between the company of one part and Alexander Henderson, of 28, Austin Friars, and Wm. Cuthbert Quilter, M.P., of 14, King's Arms Yard, of the second part, cites that the whole of the capital of £180,000 was fully subscribed before the 4th December, 1888, the date of the purchase agreement. Under the present agreement the vendors or their nominees are to receive 3,000 preference and 3,000 ordinary shares of £5 each, all fully paid up, as purchase consideration. The office of the company is now situated at 25, Abchurch Lane, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

The Western and Brazilian Telegraph Company, Limited.

The directors submit their report and the accounts of the company for the half-year ended December 31st, 1888.

The total earnings amount to £112,260 6s. 11d., as against £78,369 18s., showing an increase of £33,890 8s. 11d. compared with the half-year to December 31st, 1887. The working expenses amount to £31,220 4s. 2d., as against £30,908 1s. 6d., an increase of £317 2s. 8d.

Including the amount brought forward from June 30th, 1888

(£3,393 18s. 8d.), and the dividend received upon the shares held in the "Platino" Company, the balance to the credit of the revenue account is £38,592 4s. 5d., from which has to be deducted £13,500 for debenture interest, and £229 5s. 3d. for expenses and stamps in connection with the transfer of the Platino Company's shares, leaving £24,163 19s. 3d., of which £7,000 has been placed by the renewal fund, and £6,400 to the debenture redemption fund. This leaves £70,762 19s. 3d. The directors now recommend the payment of a final dividend of 9s. per share, free of income tax, on the ordinary shares for the half-year, making with the dividend paid in November, 25 per cent. for the year. The dividend for the year 1887 was at the rate of £44 per cent. per annum.

In the case of shares which have been divided into "preferred" and "deferred," 1s. 6d. per share of the dividend now recommended will be payable to the "preferred" shareholders, and 7s. 6d. per share to the "deferred" shareholders. The balance remaining is £39,561 17s. 3d.

The shareholders are aware that there has been, and continues to be until 1910, an annual charge upon revenue of £1,300 to repay to the capital account the discount of £36,000 given upon the original issue of debentures; of this discount £9,900 has been paid off, and a balance of £26,100 remains.

The directors propose to apply £36,100 of the balance of £39,561 17s. 3d. to secure the following advantages:—(1) The paying off of the above item of £36,100. (2) The getting rid of the annual charge upon revenue of £1,300. (3) The allocation of the £9,900 already paid, and of the £26,100 now to be paid, to the credit of capital. (4) The reduction by these amounts of the necessary capital to be provided for the new cables. (5) The diminution of the annual charge to be incurred on this account.

It is clear that any re-organisation of the debenture capital referred to would be rendered more difficult by a standing debit item in the accounts referable to its issue.

There will remain a balance to be carried forward of £3,461 17s. 3d. The payment received for the directors' fees in the Platino Company for nine months, £900, has been placed to the credit of the capital account, so that the sum originally paid as compensation will be gradually returned.

Of the total amount that may be required to provide for the making and laying of the loop cables, £36,000 is provided by the repayment made to capital account. The company has power to issue £50,000 of debentures ranking with the present "B" debentures and the balance which may be needed will be taken from the renewal fund. The loop cables when laid will largely tend to ensure uninterrupted communication over the company's line, and this additional security will entail only a very moderate charge upon revenue.

The debentures will be offered to the proprietors when required to be issued.

The annual drawing of the existing "A" and "B" debentures at par will commence in February next year, when £11,300 will be drawn, and from that date the debentures will be redeemed by progressively increasing drawings.

The directors referred the question of replacing the existing debenture debt of the company by permanent debentures at a lower rate of interest to the company's solicitors and counsel, who have advised that any measure affecting the status of the existing debentures will require the individual assent of all the holders.

Since the last half year's report, 1,310 "Platino" shares have been transferred by shareholders in exchange for 786 shares of this company.

The dividend warrants will be posted on May 16th, 1889.

The retiring directors are Lord Richard Howe Browne and Mr. Goodall, who offer themselves for re-election.

The auditor, Mr. Weise, retires, and is eligible for re-election.

Shareholders unable to be present at the meeting are requested to sign and return the enclosed proxy in time to be received at the company's office not later than Monday, May 13th, 1889.

[Owing to the insufficiency of space we are obliged to keep over the report of the meeting of this company until next week.]

The Maxim-Weston Electric Company, Limited.

The statutory first ordinary general meeting of this company was held yesterday at Winchester House, Old Broad Street, under the presidency of Mr. John Marks.

The Secretary (Mr. Samuel Boyce) having read the notice convening the meeting,

The Chairman said: Gentlemen, as you will have gathered from the notice which has just been read, this is merely the statutory meeting, and, therefore, a meeting of a purely formal character, called in compliance with the Act of Parliament, which says that within four months of the registration of any new company the statutory meeting should be held. There is therefore really no business for us to transact to-day, and there is no resolution for the directors to put before the shareholders. But now that we are here I may take the opportunity of making a few remarks, and in the first place I will inform you that we have unfortunately lost the services of two of our directors, Mr. Harvest, who, we regret to say, has been taken from us by death; and Mr. Hildyard, whose business requires his resigning his seat at the board. The object of our meeting on the last occasion was to confirm special resolutions for the reconstruction of the Maxim-Weston Company, and I may mention that since then we have applied for and have allotted out of the £12,000 shares 263,000, so that the whole of the shares in the old

company—or rather the whole of the shares that we were able to allot—in the new company have been allotted, with the exception of some 50,000. Now while I am on this point, I may mention that the liquidators have requested the directors to offer to the shareholders these 50,000, if they are disposed to take them up. I may also mention that at the time the applications were made for the new shares, a very large number of shareholders indeed applied for more than they were legally entitled to. Of course, the board were unable to allot to those shareholders more than they were entitled to under their holding in the old company. If those shareholders or, in fact, any shareholder, are desirous of tendering for any portion of those 50,000 shares on the understanding that in addition to the price they tender at there is a liability of 1s. on them, being 3s. shares with 2s. credited as paid up, we shall be happy to consider the applications. Of course, we are not particularly anxious that the shareholders should take them up, because we can place every one of those shares within 24 hours from the present time. But we think that the shareholders should have the option of taking them if they think fit. We therefore invite them to tender for the same, with the further understanding that the tenders must be made within seven days of the issue of the circular which we are now preparing to send out to the shareholders. The dissentient shareholders in the old company represented 24,000 to 25,000 shares, and I am happy to say that we have been able to arrange terms of settlement with the whole of them on what we consider fair and equitable grounds. We shall, therefore, I am pleased to say, have no litigation whatever with regard to the dissentient shareholders. Since our last meeting we have been fortunate in securing the services, as our manager, of Mr. Hamilton, who may not be known to gentlemen outside the electrical world; but to those connected with electric lighting he is very well known, and I am sure he will prove a very great acquisition to the company, and we hope with his aid to be able to do such a business as will enable us at the end of the financial year to come before the shareholders and give a good account of our stewardship. I may tell you that we have concluded some contracts, and others are now in negotiation. One contract of an important nature is for the laying down of 1,000 lights. I do not purpose mentioning publicly where it is, but if any shareholder is desirous of knowing that, we shall be pleased to give the information if he will apply privately at the company's office. It is not advisable to say publicly where we are carrying on work. This is an installation which, although an important one in itself, is likely to lead to very favourable results. We hope, as I have said before, that at the end of the financial year we shall come before the shareholders and give you such an account of our stewardship as shall be satisfactory to you and to ourselves.

A Shareholder asked when the other call of 6d. per share was due on the shares of the company.

The Chairman replied that it was due six months from the date of the reconstruction of the company—or two months from the present time. In answer to another shareholder, he said that he hoped speedily to see their action against Mr. Watt down for hearing. They claimed from Mr. Watt something like £4,000, whilst Mr. Watt claimed £1,700 against the company.

The proceedings then terminated.

The West Coast of America Telegraph Company, Limited.

The twelfth ordinary general meeting of the company took place on Wednesday, May 15th, at Winchester House, Alfred Marshall, Esq., presiding.

The notice convening the meeting was read by the secretary.

The Chairman, in taking the report as read, said the chief feature in the accounts presented is the increase of £7,831 in the gross earnings of the company during the past year. You will agree with me that this is a satisfactory state of affairs. Coming to the other side of the revenue accounts, it is a pleasing feature that this great increase in earnings has been accomplished with a comparatively small increase in the expenditure. Going now into details of expenditure, you will see that the West Coast expenses, such as the salaries, stationery, &c., have increased in proportion to the work done. We have been fortunate in having very few interruptions in working during the past year, so that the smaller expenses on the repairing steamer and the smaller expenses in maintenance of the cable would about compensate for the increased working expenses. I hope that we shall be as free from unpleasant interruptions to the cables during the current year as we have been in the past. The steamer is ready at a moment's notice to repair any damage that might occur, and generally interruptions have been remedied in a few days. Coming to another paragraph in the report we are placing a very handsome amount to the reserve this year; at the same time I wish it were even larger; but if we go on as we have done, we shall be able to recommend even a larger sum to be placed to the reserve. There has been a very great trade on the coast, and a great many companies have been formed during the year, though we can hardly expect as many will be formed on the coast this year. The tendency of telegraphy is to increase, particularly if, as we are able to do, reduce our rates in proportion to the way in which we increase our earnings. You will see that amongst our assets in the balance sheet there appears an item of £4,000, the cost of the Valparaiso and Santiago land line, which was acquired under very satisfactory terms, thereby being able to commence working at once, and at the same time avoiding competition. I am glad to say that our expectations have been realised, and we are getting a

very satisfactory return on the capital laid out. Besides this increase to our line we have made arrangements for direct communication with Pisagua, one of the nitrate ports. At one time there were as many as 80 ships in port, which shows the great importance of this place. This new extension has also proved satisfactory. You will no doubt sympathise with us in the loss we have sustained by the death of our old colleague, Mr. Campbell, who was a conscientious hard working gentleman of the board. Before formally proposing the adoption of the report, I shall be glad to hear any remarks from any shareholders.

Mr. Lewis Wells congratulated the directors upon the satisfactory state of affairs. He had taken great interest in the company ever since he had been a shareholder, and would continue to do so.

Mr. Gardiner was of opinion that it was the first duty of the directors to strengthen the reserve fund.

The Chairman thanked them for their kind expression; the directors were very anxious to have a large reserve fund, but at the same time they were anxious to satisfy the legitimate aspirations of every shareholder.

The report was then adopted.

A dividend of 6 per cent. was then declared, which was agreed to.

Mr. Alfred Marshall and Mr. Frederick Walters, the retiring directors, were then re-elected, as was also the retiring auditor, Mr. J. Weiss.

The customary vote of thanks being passed to the chairman, the proceedings were brought to a close.

Woodhouse and Rawson, Limited.

THE directors submit the accompanying revenue account and balance sheet for the period ending June 30th, 1888.

The accounts show a profit for the second six months amounting to £9,771 18s. 3d., making a total profit of £21,440 2s. 11d. for the year. Of this amount the directors propose to transfer £12,000 to a reserve account, and from the balance, £9,440 12s. 11d., to recommend a dividend at the rate of 12 per cent. per annum for the half-year ending June 30th last on the amounts paid up at that date, which, with the interim dividend already paid, will make 12 per cent. for the year; this will absorb, say, £8,000, leaving £1,440 2s. 11d. to be carried forward.

With regard to the working of the company, the installation department maintains its character for high class work; and it is found that a good class of work is obtained, and that through the best advertisement—that of the recommendation of clients.

The foreign business has assumed such large proportions as to justify the expectation of profits far in excess of anything previously anticipated. Contracts have been recently signed whereby the company will not only obtain a very large sale for its various manufactures and commodities in one of the principal countries of Europe, but also secure a large immediate profit. At present there are negotiations abroad for a contract for the supply of double the present out-put of incandescent lamps for five years, and there is every reason to hope that the negotiations will be successful.

Of the subsidiary companies in which this company holds a large interest, the Woodhouse and Rawson Supply Company of Great Britain, Limited, has done especially well, and there has been a great increase in its general business. This company supplies every class of electrical requirements, as is shown by its price lists, which are the most complete of the kind in the world.

Returns furnished by the Woodhouse and Rawson Electric Contract and Maintenance Company, Limited (Lancashire, Yorkshire, and Cheshire), show a steady and gratifying improvement, and the supply of current from the electric light station put up by the Bradford Corporation, which is expected to be shortly available, will lead to a large increase of the business.

The Woodhouse and Rawson Electric Manufacturing Company, Limited, has large orders in hand for electrical work, and has obtained the sole manufacture of several important specialities during the past year.

At the extraordinary general meeting of shareholders, held on the 14th day of December, 1888, the chairman gave a detailed account of the progress of the company's business during the year 1888, and explained that the further development of it made it desirable to increase its working power by the formation of a large company, formed to take over this and other undertakings. He also explained that the amalgamation of this company with its subsidiary companies would be very desirable for several reasons; amongst others, it was practically the only way to put an end to the founders' shares, which are now entitled to so large a share of all the profits beyond 10 per cent.

The arrangements are now nearly complete for the formation on very satisfactory lines of the new company already referred to, which will take over the business of this and other companies, and it is expected that it will be brought out in a very short time. The shareholders in Woodhouse and Rawson, Limited, will, under the proposed scheme, receive fully paid shares of the new company to the amount now paid up upon their shares, and in addition thereto a bonus of 10 per cent. thereon, half the amount to be issued to them being in preference shares and half in ordinary shares. It is also intended, in addition to paying the dividend mentioned above, to distribute certain assets reserved to this company by its agreement with the new company.

The agreement, together with details of the new company, will be explained to the shareholders at the ensuing meeting.

Newcastle Electric Lighting Company.

ON Tuesday afternoon the first general meeting of the Newcastle and District Electric Lighting Company, Limited, was held in the County Hotel, Newcastle.

The Chairman (Mr. J. D. Milburn) said they expected by the end of the month, or the beginning of next, to have the sanction of the Board of Trade and its licence to commence work. The directors had been able to make several important contracts. The dynamos and engines had been partly contracted for, and he believed they could all be ready almost immediately. Then all the boilers required for the first section of the work of the company had been contracted for, and would be delivered at the end of June or in July. The company had, after careful consideration, chosen a site for the central station at Forth Banks, and as soon as the Board of Trade licence had been received the seatings for the boilers would be commenced with, the erection of chimneys proceeded with, and the company would begin to lay the cables in order to supply the current to customers. The system of lighting adopted by the company, after mature and careful consideration, was that of the moderate tension of 1,000 volts alternating currents; and it was thought that this system, which was pretty well used, and which was pretty familiar to most electric lighting companies, would be such as to give the consumer an excellent, steady light. The company not only pretended to light Newcastle, but it had powers to light the district, and might have to adopt a higher tension—something like 2,400 volts alternating current, or even more—and under these circumstances the directors had held it wise and judicious to lay such cables and such transformers as would carry the higher voltage. Some of their electric lighting friends in London were adopting these higher tensions, and the company would have the benefit of their experience in that direction. At present the company was going upon what might be called safe lines, and was adopting what was considered to be a very safe voltage, and one well within control. The machines adopted were those of the turbine system, well known in this district. It had been applied to several works, and also to a great number of steamships, and had given very great satisfaction. These engines had been ordered from Messrs. Clarke, Chapman & Parsons, and were being constructed with the very greatest care, and he had no doubt they would give every satisfaction to the company. The boilers, which were three in number, and of the high pressure of 140 lbs. to the square inch, were being made by Messrs. R. and W. Hawthorn, Leslie & Co., in their works adjoining the company's station at Forth Banks, and it had been a very particular care of the directors to have more boiler power even than was necessary for the first section. So much for the work which had been going on in the way of erections. With regard to the business operations of the company, the business staff of the company had not been idle. They had been canvassing, and at the present they had signed applications for lighting amounting to 35,000 candle-power incandescent light, or 3,500 lamps of 10 candle-power, which was about half the trade required to keep the first section fully going. They were daily increasing their connection, and now that the tradesmen and others likely to make use of the light saw that the company was in earnest, and setting about its work in a business-like way, they gave their proposals very careful consideration, and the directors believed the result would be that in a very short time there would be more business than the first section of the work would be able to undertake. The price the company intended to charge was 5s. for 10,000 watt-hours, or 6d. per Board of Trade unit, with discount to consumers according to the quantity of light taken. They had now something like 29 or 30 applications for the light, some of whom had already begun to have wires laid on to their premises. The directors had every confidence in the successful working of the company, and did not fear anything about capital. The difficulty hereafter would be to refuse capital. The nominal capital was £50,000 in 5,000 shares of £10, and it was only proposed to issue 2,000 at present.

The meeting then terminated.

The Liverpool Electric Supply Company, Limited.

THIS company issues 20,000 shares of £5 each at a premium of 5s. per share. The company was formed in 1883 with a nominal capital of £10,000, which has since been increased, to meet the extension of the business, to £300,000, half of which amount has been subscribed. The business has been remunerative from its commencement, paying dividends of 5, 6, and 7 per cent. The assent of the Corporation to the application made by the company to the Board of Trade for a Provisional Order for an enlarged area of supply, so as to include Bold Street and other important streets, must very much strengthen the position of the company, and place its business on a more satisfactory and permanent basis. The company has now three central stations in operation, and other favourable sites have been secured. It is not proposed to call up during the present year more than £1 per share, together with the premium.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the weeks ending 3rd and 10th May, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were respectively £1,098 and £2,147.

LEGAL.

Edison and Swan v. Anglo-American Brush Company.—Before Mr. Justice Kay in the Chancery Division of the High Court of Justice, on Monday, the Attorney-General said he was instructed to move on behalf of the plaintiffs for an interim injunction on the usual terms. His Lordship would remember that there had been a very heavy litigation in which the Brush Company were practically, though not nominally, the defendants. There was no doubt about the infringement which was in respect of certain lamps. If the defendants would agree to be bound by the judgment of the House of Lords, the plaintiffs would do the same; in other words, if the defendants submitted to the interim injunction the matter would be practically determined by the decision of the House of Lords. He asked for an interim injunction on the usual terms, the plaintiffs giving an undertaking in damages, and the costs to be costs in the action.

Sir Horace Davey, for the defendants, said that if the Attorney-General insisted on an injunction he could not resist it, though he should have thought the situation would have been met by the defendants keeping an account. He was quite willing to be bound by the decision of the House of Lords.

His Lordship granted the injunction asked for, the plaintiffs to give an undertaking in damages.

Edison and Swan v. Schanschieff Electric Battery Syndicate.—This case, the Attorney-General said, was very similar to Edison and Swan v. Anglo-American Brush Company. The defendants consented to submit to the terms agreed upon in that case.

Order accordingly.

United Telephone Company v. Dugdill.—This action, which was heard on Saturday before Mr. Justice North, was brought for an injunction to restrain the infringement of two patents for a transmitter and receiver. The defendant had failed to put in a defence, and the case came on as a short cause in default of appearance. His Lordship granted the injunction as asked, with an inquiry as to damages, and ordered the defendant to deliver up the infringing instruments within seven days, and to pay the costs of the action as between solicitor and client, the patents having previously come in question and been upheld. The costs of the inquiry as to damages were reserved.

SCHAFER AND BUDENBERG.

THE well known house of Schäfer and Budenberg has recently issued a completely new edition of their catalogue, a copy of which they have kindly sent us. The first thing to strike us is the excellent printing and "get-up" of the book, and on looking for the imprint we find that it is printed by the firm themselves, at their chief works at Buckau-Magdeburg. An idea of the extensive scale upon which business is being done by this firm may be gained from the fact that with respect to one class of goods alone, namely, pressure gauges, they have manufactured since their establishment in 1850 over a million, and the present annual production is 70,000. The business has increased so rapidly during the last few years, that the works have recently had to be greatly enlarged, 1,300 men being constantly employed. The new catalogue contains illustrated descriptions of a number of articles always in demand among engineers, some of them being specially designed for use with electrical machinery. A very useful novelty here described is the pocket tachometer, made on the same principle as the larger indicator, now familiar, but intended for use by hand. It is very light and portable, and will indicate the speeds of the revolving shafts with the same degree of accuracy as the larger instruments. The pocket tachometer is employed by holding it with a slight pressure of the hand against the end of the rotating shaft, so that the steel bit provided on the spindle end of the apparatus enters the centre mark of the shaft. The instrument will then indicate directly and continuously the precise speed of rotation of the shaft. Each instrument is packed in a leather case, which also contains two sets of toothed wheels, for increasing or reducing the relative speed of the tachometer in the proportion 1 : 2; the instrument being ordinarily divided for 100 to 1,000 revolutions per minute. Particulars will also be found in this comprehensive list of the Buss governor, of which 14,000 have been sold. Amongst the other testimonials to its efficiency is the following strong one from Mr. John Watson, of Earnock Colliery, Hamilton, who was, we believe, the first to introduce the electric light into a mine. He says:—"It is fitted to a 20 H.P. coupled horizontal engine, which drives the dynamos in connection with the electric plant erected here; the engines when erected were fitted with automatic expansion gear, which never gave satisfaction, but since your governor was put on the engine runs much steadier, and consequently the electric light (Swan's incandescent lamps) is always good." Other varieties of governors and expansion regulators are also described, as well as gauges, counters, indicators, lubricators (including one specially denominated the "dynamo" lubricator), and other engine room appliances, the whole forming a reference book of considerable value.

ELECTRIC LIGHT PROVISIONAL ORDERS.

BOARD OF TRADE INQUIRY.

(Continued from page 536.)

IN continuation of the speech of Mr. Cripps that gentleman said:—It was admitted as to another point—that of the curve—that his method of dealing with it was as safe as that of Mr. Moulton's Company. Mr. Crompton had stated that that was a matter which could be easily met if they had a large number of small generating units. Mr. Cripps said he proposed to deal next with the question of electro-motors, and he would admit that at present no electro-motor had been invented which would deal satisfactorily with the alternating system. But they could use a motor that was applicable to the direct system. There was a difference of opinion among the electrical experts on the point as to motors. Whilst it was agreed that the matter had been carefully considered, they none of them admitted that the difficulties could not be overcome. But if, as was probable, an electro-motor applicable to the alternating system was introduced, then there would be no difficulty. But even if not introduced no difficulty would arise to his client, because so soon as a demand for motor power arose they could supply by means of the direct system just as well as any of the other companies. There was, said Mr. Cripps in conclusion, an overwhelming preponderance of scientific opinion in favour of the Metropolitan, as being the best system of lighting. Mr. Ferranti was in favour of the alternating system. Dr. Fleming, Mr. Gordon, and Dr. Hopkinson were in favour of it. Mr. Spencer, of the Westinghouse—the largest system in America—was in favour of it, and said that for the 1,000-volt pressure the alternating system was the best. Prof. Forbes was in favour of it; Mr. Siemens gave it qualified support; and strong evidence for it was given by Mr. Crompton. There was no doubt that it was the coming system. Having quoted the points in the Board of Trade letter to the London County Council, Mr. Cripps said that every point there raised the Metropolitan Company were prepared to satisfactorily meet, and therefore he asked that their Provisional Order should be granted by the Board of Trade.

Mr. PARKER then replied on behalf of the London Electric Supply Corporation, and, referring to the Board's letter to the London County Council, expressed the hope that the Council would not take action without calling evidence.

The INSPECTOR remarked that it was impossible to say what the London County Council would do. Their representatives had been present during the enquiry, but had taken no part in the proceedings.

Mr. PARKER said that the corporation which he represented was the most important of all the companies, because they had by far the largest amount of capital, and their aims were greatly in advance of the other companies. The nominal capital of the House-to-House Company was £350,000, of which £41,000 was paid up; the Electric Power Storage Company had no capital subscribed or paid up; the Chelsea Company had got a capital of £32,500; the Notting Hill Company had £100,000 nominally, but really had nothing beyond the money requisite for the preliminary expenses; the Kensington had nominally £350,000, but only £38,000 paid up; and St. James's Company had £100,000 capital, with £28,000 paid up; while the Westminster Company had no paid-up capital and no shareholders, but only a gentleman who had promised to subscribe towards a nominal capital of £100,000. The Metropolitan Company was certainly in a thoroughly sound condition, with £500,000 authorised capital and £131,000 paid up. The London Company had an authorised capital of £1,350,000, had spent over £400,000, it had £800,000 absolutely subscribed, and would in a very short time have spent over half a million. This would give two great dynamos of 5,000 horse-power, and two smaller ones, which he particularly desired the Inspector should bear in mind.

The INSPECTOR remarked he had very good reason to remember one of them.

Mr. PARKER was happy to know that it was not he (Major Marindin) that was killed. It was certainly an unfortunate piece of business that after his proposal to go down and see the place it should blow up. Unfortunately machinery did sometimes blow up at the wrong time, but he was not likely to be misled, as had been suggested, into thinking that the effect of the occurrence was that the whole thing had gone to pieces, and that, in his view, the London Electric Supply Corporation had gone with it. Then there was the expense in connection with the Grosvenor Gallery mains and the station there; the engine and plant being very large, because they were vast premises. At Deptford they were large enough to do, if they were put to their full uses, some four or five times the number of lights that they proposed to start with, and the erection of two extra dynamos would give them power of raising the 250,000 lights, which the present plant would give, to 450,000 lights, and it would still leave them, when all these were erected, far within the expenditure of £800,000 which had been already subscribed. Those were nett figures, after allowing for some £150,000 for what they called "spares," so that, in fact, for considerably less than an expenditure of £800,000, they should be, and were, absolutely in a position to supply the public with some 600,000 lights in the gross, 450,000 nett. Far more consistent with the ordinary A.B.C. of political economy was a suggestion made by Mr. Preece, who seemed to have come to talk very much more like a political economist than an engineer. Mr. Preece suggested something about amalgamation. No doubt that was an

* This is incorrect, see last week's "Notes."

obvious tendency; there was no question about it where the companies with large capitals were competing. But fortunately that was a matter in the hands of the Board of Trade and of Parliament. The great railway companies, in one shape or another, but always for the same purpose, had tried on, so to speak, amalgamation over and over again; but Parliament had always been perfectly firm in the matter, and the Board of Trade and Parliament might be allowed to be likely to be perfectly firm in this. Besides, rates were not the only thing. Although rates might be uniform, there might come a point in their downward tendency where they ceased to fall, in consequence of competition. There were other forms of competition which never stopped—competition in appliances; energy, and civility. In support of what he said with regard to potential competition, his learned friend pointed out that the company never need fear immediate competition, but could always mend its way in time, and reform when the necessity arose—when they were in danger, and then relaxes when the danger was over. That was one of the many forms of second-rateness, which would always take place in the course of 42 years. Mr. Moulton, who had not been sufficiently instructed in the science of political economy, said that competition was all very well between a gas company and an electric lighting company, but when there was competition between two electric lighting companies the result would be the raising of the price of electricity, although competition between a gas company and an electric lighting company would lower the price of each commodity, because, he said, the multiplication of capital in electricity would tend to raise the price, and not to lower it. And then he went on to say that under the competition between electricity and gas the result must be to bring down the price of both. If competition between two electric lighting companies would not bring down, but keep up, the price of electricity, in consequence of the multiplication of capital, why on earth should not the capital, which would be jointly invested in the gas company and in the electricity company combined, have exactly the same effect? If such an effect of the multiplication of capital were mechanically possible, the capital of the gas company would have just the same effect as the capital of the electric lighting company, as though it would not be equally possible for a gas company and an electric lighting company to agree on the equality of price as between gas and electricity; as though the two could not be equated—as though the price of the one commodity could not be stated as the price of the other—in other words, as though gas and electricity could not be handicapped. It would be perfectly simple for them to say: "Now, then, electricity at a certain price shall be equal to gas at 4s., 5s. or 6s. per thousand cubic feet, if saleable at the price in question." No doubt it would be sold at it, and that would be an agreement made, and if there were any other matter to be taken into consideration between the representatives of two such companies who were negotiating that matter, they would very soon consider, and they would fix the relative prices accordingly, so that it would come to this, that two electric companies could combine to maintain a high rate, so a gas company and an electric company could combine to maintain a correspondingly high relative rate, both for gas and electricity. In fact, both pairs of companies could equally combine and equally compete according to the general laws of combination and competition. To a certain extent only gas and electricity were non-competitive, and in some measure they appealed to a different public. Electricity, in a great measure, for house lighting at all events, must, for a very long time to come, be a rich man's light, though not, of course, entirely. The poor, for many years, would not be able to think of it for house lighting, partly because of its price, which must be very much higher than gas, and partly also because it was not fuel, a point which a great number of persons had left out of account. The poor could not afford a cold light, because that necessitated their having fires as well. Electricity was essentially a cold light and gas was essentially a hot light, and although gas was no doubt unwholesome, and the heat given out injurious, that was not a point which the poor considered, nor would they consider it for many years to come. The richer people did consider it, and it was one of the points which guided them in taking the electric light into the house. Therefore, to a certain extent, gas and electricity did not appeal to the same purchaser, to the same market, and therefore to some extent, but not to a considerable extent, they were non-competitive. The competition between them was not complete, as, indeed, it could not be by the force of the terms, not so complete as it could be between two electric lighting companies—between electricity and electricity. Putting aside all these fallacies, the broad view and the statesmanlike view of competition as to electric lighting, that which seemed to have been adopted by Parliament in 1886, 1887, and 1888, by Lord Camperdown's Commission, and the legislation which was the outcome of it, was delayed by Mr. Chamberlain, whose committee, looking at the way in which it dealt with the Act of 1882, made one or two very serious mistakes in dealing with the subject. Mr. Chamberlain was at that time, so to speak, fresh from Birmingham, full of the importance of the local authority. He was the impersonation of the local authority interest, and he thought a great deal too much of local authorities at that time and far too little of the purveyors of the electric light. His sole idea was to get it as soon as possible into the hands of the local authority, so that no private profit which might accrue from its purveyance should go into the general coffers of the local authority itself. All that he did in that direction was to postpone for several years the application of the electric light in England, and to bring about that state of things which was noticed by Mr. Moulton, namely, that other countries, notably America—even other countries as

backward as Italy—were really at this moment ahead of England in the supply of electric light. Now, all that had been reversed by Parliament in 1886 and 1888. The moment the legislation was complete the purveyors of this commodity were really placed upon a commercial footing. What was the result? Not four or five companies, but two powerful companies—the London and the Metropolitan—thoroughly well equipped, ready, and in earnest, and each of them far the best systems for large populations and large centres; so in effect, except for the unfortunate step taken by his friend's company with regard to the Strand and to Marylebone, they were both companies to which no objections could be taken. Therefore, let them both go on to do their best for the population and themselves. The result of the legislation of 1888 was vastly different to anything which ever could have come about in the legislation of 1882. Let capital and all that it commanded in the way of genius and energy have full swing, for thus only would the public get the benefit of the improvement which constant experiment and inventiveness always brought and only could bring about. There was no doubt whatever that the company first of all with a large capital, and secondly with a large area to work upon, could do the work better and cheaper than those who had not those advantages. It was true of all industries that they always got things best and done the cheapest on a large scale. The weakest, the poorest, the most lethargic, incompetent and inefficient companies would go to the wall, and so they ought, and the sooner they went the better for them; and it would have been better if they had never come into existence at all. But they would not produce monopoly. As to compulsory areas, he said it meant that when they went into a district they were to lay their mains all over a certain portion of it. There was no guarantee that there would be a single light asked for, or that any one would set up an installation or light a single lamp. That was a folly that involved a very great waste of capital, for which, he presumed, the consumer must pay, because it was perfectly obvious that as long as a lot of unproductive capital of that kind remained underground, it was absolutely impossible for any company to lower the price, or to do much for consumers over the portion of it that they might happen to have at that moment. Mr. Moulton said that the transformer allowed of lighting in patches, the storage did not. Not only did he (Mr. Pember) admit that when taken in connection with the requisition clause, but he insisted upon it as a very great advantage. The transformer system could, with a large area such as they proposed to have, lay their trunk mains, and if they found at a very considerable distance from the commencement of these trunk mains a piece of their district that did want light, they could pass by that district. But it was not true in the sense of "spotting"—choosing the spot they would do, and ignoring the spots they would not. First of all, they were obliged to lay the trunk mains wherever the light was really wanted; secondly, they were obliged, upon certain conditions under one clause, to lay down a distributing main, and thirdly, any person within 25 yards of their distributing main could force them to lay on the light for him. So they had three stages of requisition, the requisition of trunk main, the requisition of their distributing main, and the requisition of the house-to-house. At first sight the corporation scheme was the most taking of all, and a close inspection confirmed that view. They were rid of all the promises, and endeavoured to get rid of all the nuisances which arose from manufacture, but one did at the same time find it a little difficult to believe in the absence of an avoidance of steam, and smoke, and vibration, and noise. At all events the chances of others who promised to get rid of all these things had not past experience in their favour. It was obvious that the London Corporation opposition in that respect was not a thing of promise, but a certainty. They did absolutely rid London of manufacture. The 2,000,000 lights in the area of London covered by all the orders might be easily reached when the thing once got fairly in operation; 50 tons of coal for 100,000 lights would give 500 tons per 1,000,000, or 1,000 tons a day of extra coal carted in these parts of London if the system of having generating stations in a district was adopted for them all. That would illustrate the difference between the generating system outside London practically and on the river side, and that of the Corporation at Deptford, and many generating stations inside London. They should consider the population in the areas covered by these orders. On this point of the cartage of coal, what would be the result if they were to hand them over to a set of companies who had their generating stations in their midst? The answer would be the addition of 1,000 tons a day to the coal cartage, with a consequent addition to the wear and tear of the roads. If he said the Board of Trade had to select one system, that of the London company would, despite the competition, be found the best. That observation would be appreciated by the learned counsel, for they used it themselves in regard to the companies they represented. So much so, in fact, that the words in one of the novels of Peacock came to his mind—

"On mature consideration
And careful meditation,
Of all the pretty projects that have here been shown;
Not a scheme in agitation
For this world's amelioration
Has a grain of common sense in it except my own."

(Laughter.) But seriously the system of the London Electric Supply Corporation was the simplest and most convenient, as it provided the article of consumption elsewhere and delivered it in

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London as water was delivered. The only buildings required would be a few distributing stations such as the Grosvenor Gallery. When once their mains were laid under the streets the only inconvenience with London would be to set up the small distributing stations with a floor space of 2 feet by 3 feet, or 6 feet square per 1,000 lights. There would be some wall space for hanging up switches and gear, and the floor space would be for the converters. In fact, a moderate sized room, say of 60 square feet, would suffice for 10,000 lights. The company provided at a pinch for 450,000 lights—a larger number than any of the other companies. That was the net number, and did not include the 150,000 spare lights. Having at some length urged that the Corporation were as well off as regarded the price to be paid for their coal and better off as to savings, he ridiculed the idea of any probability of a breakdown. They had, he said, two trunk mains running to each of the three distributing stations, with two dynamos to each. Each dynamo and each main was capable on an emergency to do the work of two dynamos and two mains, proving that the supply to each distributing station was really in duplicate. That was evidence of the reserve power. Therefore, before the supply was cut off, there must be two dynamos out of gear and two mains must break down. He could not help thinking, therefore, that when Mr. Moulton spoke of there being darkness if one "gigantic dynamo" went wrong, he had not duly considered the matter. With two dynamos working to each set of mains and two sets of mains working to each distributing station, he (Mr. Pember) did not see how darkness would follow a dynamo going wrong. The system was both simple and safeguarded. By the mains the electric current was brought up to one of the three distributing stations at 10,000 voltage which was at once reduced by the transformers to 2,400 volts. It was thus carried through the streets of the Metropolis partly by underground mains and partly by overhead wires. It was no question of experiment, but was really done at the present time. Having been reduced by the transformer it passed along the distributing mains, which were put where and when they were necessary for consumption. Then there was a second transformation from 2,400 to 100 or 50 volts, as the case might be. That, too, had been done for some time, and was therefore no experiment. The large consumers would have their own converters, but for smaller ones there would be a converter for every 20 or 30 houses. According to Mr. Ferranti the loss of electricity which would result from going along the trunk mains would be 1-500ths per mile, or 7-500ths for the seven miles between Deptford and London. Thus the loss of power in bringing up the current would be 1-40 per cent. Not only was the London system complete and simple and the newest, but it was that which showed the greatest stride made for many years in practical electricity. Against the system the phrase of Sir William Thomson—"a gigantic experiment" had been taken up by all the objectors. But Sir William had greatly modified that expression. And, in fact, it was not in the true interpretation of the words an experiment at all. It was what Sir William Thomson meant to convey "a gigantic application of experiment." Experiments took place in laboratories. Everything attempted on a larger scale than hitherto tried, was in a sense a great experiment. But scientific men knew the difference between an experiment and the application of experiment. What were the railways throughout the country but applications of experiments at first, and in the case of the line from Birmingham to Manchester when it was opened, the death of Mr. Huskinson was caused. But from the application of the experiment the railway system of England soon passed into successful operation. That which was now being proposed with the electric lighting was only applying on a large scale the principles well known to electrical engineers. That was stated in express terms by Sir William Thomson in his evidence. The objectors to the transformer system had given loud voice to short-circuiting and its alleged consequences: to the difficulties of jointing, to the importance of insulating mains carrying a 10,000 volts current, to leakage from both primary and secondary mains, to the stoppage of supply through the breakdown of the mains with consequent panics in theatres and a good deal more. They had spoken of variability of pressure in the high tension alternating current, the loss in transformers through fluctuation of demand, the injurious effects of transformers on the life of lamps, the danger of transformers in private houses, and the impossibility of supplying the electrical power in consequence of no known motor having been adapted to the alternating system. Those and other matters he would reserve for the close of his speech the next day.

The inquiry was adjourned till Wednesday.

On this, the 18th day of the proceedings before Major Marindin, Mr. PEMBER, Q.C., continued and finished his reply for the London Electric Supply Corporation. He said, he should like, first of all, to say something as to the question of the Board of Trade unit, some sinister suggestion having been made as to the motive which animated those he represented. He was told that when at Brighton he (Major Marindin) had said something to the effect that the Board of Trade had made up their mind not to adopt a unit.

The INSPECTOR remarked that he had informed the Board of Trade that they should decide not to adopt a unit.

Mr. PEMBER said he should like to urge an argument or two in favour of the unit.

The INSPECTOR replied that he was quite ready to hear anything which could be said in its favour.

Mr. PEMBER went on to say that the unit as used in the corporation schedule was to be the energy contained in a current of

10,000 amperes conveyed under an electromotive force of one volt for one hour. The original Board of Trade unit was that divided by 10, viz., 1,000 amperes. The Grosvenor Gallery charge was 7½d. for the present Board of Trade unit. Supposing they came to the conclusion that, without damage to the corporation and, of course, with advantage to the consumers, they could drop the price of electricity, the question was what was the smallest known coin. It was a farthing. That would be the smallest drop they could make on the Board of Trade unit. That being so would give more than 8 per cent. Taking the case of the gas companies, they used for purposes of measuring and charging 1,000 cubic feet and the price was 3s. 3d., or a good deal more than 7½d. So that a drop of a farthing to them, supposing their profits increased so as to allow of a decrease, would be only like three-quarters or two-thirds per cent., which was very small. Therefore, with the large unit which they had, they could, with advantage to themselves and the consumer very well drop from point to point. But until there was some change in the production which would warrant such a step it was obvious that an electric lighting company could not, with such a unit, drop from 7½d. to 7d. Unless there was some good reason for retaining the Board of Trade 1,000 ampere unit, it would be better that it should be multiplied by 10, so that the companies would have a similar advantage to that possessed by the gas companies.

The INSPECTOR said the remarks on that point of Mr. Pember would have the careful consideration of the Board of Trade and, if necessary, they would reconsider their position.

Mr. PEMBER was glad to hear that, although he was not then asking the Inspector to hear all the arguments pro and con. Still, unless there was some very strong reason to lead the Board of Trade to adhere to their present position, he hoped they would alter it in the direction he (Mr. Pember) suggested. Proceeding to refer in detail to the objections to the London Corporation system, he said they were in inverse proportion to the disinterestedness and eminence of the objectors, whereas the favourable criticisms of the system were in direct proportion to the disinterestedness of the persons who made them. Many of the objections hung together and came under the head of insulation. The first—that of short-circuiting—was connected with the jointing and had been anticipated by Mr. Ferranti. He (the speaker) admitted that the testing of the main by itself was not proof positive that the jointing would stand as well as the main. But the mains had been tested up to 10,000 volts. Without going further he might urge that, if the joints were carefully made with all the provisions and appliances possible to science and if a main bit of the main could stand 10,000 volts, the joints were not going to be 100 times worse. There was a margin of 100 to 1 between the electricity which would pass and the 10,000 volts at which their mains had been tested. As a matter of fact, Mr. Ferranti had made a test only within the last few days and found that it would stand a pressure of 650,000 volts.

Capt. CARDEW wanted to know upon how many joints the test had been made.

Mr. PEMBER replied, on one joint.

The INSPECTOR said the matter was hardly one to be referred to now. It was one about which the Board of Trade would satisfy themselves.

Mr. PEMBER, however, thought that it was not unbecoming in him to say that when the test was applied to one of Mr. Ferranti's joints it was found to stand the pressure of 650,000 volts. That seemed to him to be a conclusive answer as to the question of safety, although of course Captain Cardew would satisfy himself on the point, and it was to be hoped that he would go to the company's works to do so. Mr. Ferranti also said on the subject of jointing that any effect of high voltage would show itself at once, and that there was no more reason why there should be a decay of a well-made joint than of the main itself. It was no more a question of time than in the main insulating conductor. There was no more reason for anticipating a gradual decay in the whole main joints than in the insulated main conductor itself. He had worked underground at a pressure of 2,500, so that 10,000 volts would be only a jump of four times from the present experience. Dr. Fleming, in support of Mr. Ferranti, had said that the insulation of the trunk mains of the Corporation was perfectly feasible. Of course, the higher the degree of electromotive force the greater the precautions required to be taken; but there was no impossibility in doing it. It was not a case of running one's head against any law of Nature. The real meaning of the evidence was that the jointing difficulties which Mr. Ferranti had absolutely overcome required care, skill, and experience, and that would bring it to a successful issue. Mr. Ferranti's jump from 2,500 to 10,000 volts was said to be justified by the present state of scientific knowledge of electricity. Sir William Thomson having been asked if there was any practical difficulty in going from 2,400 to 10,000 volts, replied, "I do not think there is any insuperable difficulty, but it is a very great experiment;" and then, when asked if electricians possessed sufficient amount of knowledge on the subject to deal with it, he replied, "Yes, I think so." If science was to be advanced at all in practice they must have the first 10,000 volt main laid down somewhere, and the first man who laid it down could not have practical experiences; he could only have the experiences from laboratories and electrical theory. They could not have experience of a system which they were going to try for the first time, but they could have certain knowledge derived from their laboratories and electrical theory which was possessed in the present case, and which Sir William Thomson considered was sufficient for their purpose. He was asked, "Having regard to the knowledge which electrical

engineers already possess, have you any doubt that they will be able to overcome any difficulties they will meet with?" and he answered, "I have no doubt that they will." That explained Sir William Thomson's first remark—that it was a very great experiment. It really was not an experiment itself, as the experiment had been done in laboratories, but the system was an application of the result of experiment, and was justifiable. With reference to Mr. Preece, Mr. Pember said that that gentleman did not speak of the system of the Corporation as impossible, but he said that it was a gigantic experiment. He said that generally he was a decided advocate for lighting large areas by the alternate current transformer system, and that he considered it simply a commercial question of *s. a. d.* He added that ample evidence had been given that if a balance sheet were struck between the reasons *pro* and *con*, he thought it would be found that they balanced each other pretty fairly, and that commercially he did not oppose their system. There was, he said, almost as much to be urged in favour of one station down the river, as for central stations. Then as to the experiment, he said that his objection to the London scheme was its connection between Deptford and London by means of the mains. He further said: "I regard the proposal submitted to this tribunal, as regards the mains, very objectionable, and that part of the system of the corporation is not in consonance with the rest of their scheme. It is a very weak point, and one which will require further and more mature consideration." That, however, was simply and solely an objection to the way in which the corporation meant to bring their mains up to London. His objections were as to the difficulty of transporting energy from Deptford to London, and he said he anticipated difficulties of insulation, of jointing, and of disturbance to contiguous telegraphs and telephones; but the pith of his objections was summed up in his reply:—"My difficulty is simply the connection between the dynamo and large transformer at the distributing station in London." With reference to the supposed danger to persons, and that the telegraphs would suffer, Mr. Preece was asked as to the difficulties if a particular form of cable insulation on the outside were adopted between Deptford and London, and he said that the disturbance would depend upon there being a curve between London and Deptford, and that if we could set up an absolutely straight line, electro-static induction would not take place; but there would be, he said, earth induction. If the curve could be avoided, the safety of the public would be satisfied. He was further asked: "Have you any doubt whatever that a cable carrying their current from Deptford to London can be made which shall get rid of what I call the Post Office objection?" and he answered, "None whatever." That was followed by another question, "And that it will ensure safety to the public?" to which he answered, "Yes." What more, then, was required? Was not that absolutely conclusive from the most eminent witness called during the whole case? After having considered the matter carefully, and looked fully into the system of the corporation, so far as regarded the main between Deptford and London was open to any objection, he said he had no doubt that modifications could be adopted with regard to insulation, and as affecting telegraphic and telephonic wires and for the safety of the public so that difficulties could be absolutely overcome. That was the evidence of a thoroughly independent person and trustworthy in every way, and only hostile to the Corporation as to the original form in which it was proposed to have the trunk main. With reference to the question of a stoppage of supply from a breakdown, that had also been anticipated by Mr. Ferranti who, in his evidence, said that it would be a very simple act to switch on from one machine to another and would only take a second or two. All the silly talk about panics at theatres might be treated with ridicule. A panic in a theatre, if it could arise from a sudden blaze, it could be anticipated and would as suddenly cease. But he could not understand the common sense even of the people of London being at such a low ebb that the momentary eclipse of light—a momentary darkness of only a second or two—would cause them to think a catastrophe would follow. He could not conceive of the public being so ignorant of what had been the recognised fault up to the present of the electric light in its being liable to momentary cessation. But according to the evidence the eclipse would be over before a lady would have time to cry out "Oh, my!" or a gentleman to say "Oh!"—something else (laughter). It would be very easy for one engine to be switched on and another dynamo to be used. It was said that the main might break, and that the transformer system lived from moment to moment. Well, that was the case with everybody. They did not want a gas auxiliary for the transformer system. The scientific witnesses had described how it worked. There was a feeder to the networks, for each distributing station was really analogous to the generating station of the direct system. To each generating station there was a network of mains which could be fed from as many points as might be found convenient, and by as many transformers as were necessary. All the transformers would be coupled—would be in parallel—and if any one could fail a new one could be switched on with far greater ease than a fresh dynamo could be switched on by the direct system. In the case of a transformer breaking down there was the rest of the apparatus which could be switched on to do the duty. With reference to the supposed leakage from the primary to the secondary main, it had been spoken of as a recognised difficulty in working the transformers. But that was a difficulty only in the initial stages of electrical distribution which had been overcome for some years. There was not the supposed danger of transformers in private houses: for, in the first place, there would not be a transformer in every house.

For small consumers there would be a transformer for every 30, 30, or 40 houses. Mr. Heaphy, the representative of the fire insurance company, had stated that his company did not think there was any danger. Besides, Mr. Ferranti had used the transformers in houses for the last five years. The experience of five years was a tolerably satisfactory experience, especially as the voltage was the same as there would be in the distributing mains. Then as to the variability of pressure, that was an objection which was a sort of "try on." But it had been dismissed even by two hostile witnesses, and it was said that it would be just as easy to maintain uniformity of pressure by the transformer as by the other system. The corporation plan would preserve high constancy of electrical pressure; for, as everybody knew, constancy of pressure could be maintained much easier by high pressure than by the low pressure of the direct system. As to the loss of efficiency, the transformer efficiency was greatest when doing an average load, but a moderate increase or decrease of the load made very little difference, and it was admitted that the load must fall 90 per cent. before the efficiency fell 30 per cent. One of the last objections was that there was no known motor suitable for working in connection with the transformer system. But that was not true, for there was a motor in existence, although it was not in the market. One of the electricians of some eminence was asked the question, "Have you any doubt that the difficulty of finding a proper motor adapted to the alternating system will be got over?" and his answer was, "Certainly not." Another objection was as to the life of the lamps, and Dr. Fleming, on that point, said there was very little difference in the life of the lamps between the alternating and the direct system. The last objection was as to the question of expense of the corporation system. But their cost for the 250,000 lamps was only about £500,000; whereas, as far as he could make it out, for the direct system the probable expenditure for 25,000 lamps would be £108,000; and the corporation knew the end of their expenditure. The evidence of one who was no enemy to the direct system said that the storage was very expensive, and suitable only for a limited area. For a large distribution he preferred the alternating system. The storage batteries were too expensive, and Sir William Thomson said that they were impossible on a large scale. Apart from the great expenditure in the battery system, there was a great depreciation. The decay in the positive plates in the battery was 33 per cent., going down to 25 per cent., and the decay in the negative plate was 14 per cent. There was an average decay in the two sorts of plates—taking the highest and the lowest percentage—worked out at from 23.50 per cent. to 19.50 per cent. There was really a new plate required every five years. According to the reliable figures, a total repair would be wanted once in every five years; and that was exclusive of the engines and mains. What had been said about the price of the corporation? It was 8d. per Board of Trade unit. The Chelsea price was 10d., but in the Provisional Order it was 8d., and they charged 8d. in Chelsea. But in the transformer system from the Grosvenor Gallery it was only charged 7½d. The Metropolitan price was 8d., although it was true that in the St. James's agreement they were going to charge 7d. But they had not had the experience of working of the corporation. After taking exception to the system and order of the Chelsea Company, Mr. Pember said that it would be a monopoly and a syndicate of purveyors of plant. And much the same sort of indictment could, he said, be made against the Electrical Power Storage Company, which was not, in the proper sense of the term, a light-purveying company. It was, he contended, only to light-purveying companies that Provisional Orders should be granted. The purveyance of plant and of light ought to be kept in different hands. The public desiring light ought not to be handed over to the mercy of a group of patentees. If their order were granted, the Board of Trade would be encouraging the very worst form of monopoly that could be established, viz., the monopoly of parties who would tie down the district to one particular form of supply; and that would be the worst form of monopoly which could be created by Parliament. Against the Westminster and the St. James's he had to say that they ought not to be granted exclusive rights over small and lucrative areas, as it would not be fair to large companies like the London Corporation. It would be very unfair to allow a company like the St. James's to pick plums out of the pudding just where they chose, and certainly such picking of plums would seriously cripple large undertakings. The only way to deal properly with the electric lighting of London was on a large scale. If the corporation were given a large district such as they asked for, they could take the rough with the smooth, but if the smooth were taken away they would be left only with the rough. Their resources would enable them to give the best supply on the hypothesis that they had the good and paying as well as the other portions of the district. Pointing to the difficulty he thought there was in districting, Mr. Pember said that it was not easy to hold the scales—to give an apparently good bit to one company and another good bit to another company; for there must always be a very considerable amount of uncertainty and speculation as to how districts would turn out commercially. It was impossible to compare districts at all accurately as to fruit-bearing, as he might call it. One part might, from some unforeseen element, turn out to be worthless, and, on the other hand, another part might be a gold mine. Then, again, adding to the uncertainty was the highly problematical character of the future of electricity, and also whether the current would be required for both lighting and motive power. There was a great difference in districting for the electric lighting companies and in the districting for gas companies. The districting for gas had been fairly well

It was so comparatively cheap when it was first introduced that it was obvious that its universal adoption was an absolute certainty and was only a question of time. But in the case of the electric light they could only guess at the chances of the probable uses of electricity. It was a far more complex matter than gas, and mistakes made now would be very difficult to set right, for the vested interest in the shape of the company in possession could be very strong. A mistake made at present in the settlement in the direction of districting would probably hold good for the 42 years with all its consequences to the consumer, the local authority, and the company which was excluded. Those were considerations which should be seriously borne in mind by the Board of Trade and Parliament before giving their decision on so important a question. With reference to the agreements entered into by the Metropolitan Company with the districts of Marylebone and the Strand they were bad and not such as the Board of Trade should sanction. The Board should, as a matter of general policy, consider those agreements, not as private matters but as parts of a provisional order, involving general policy and also as involving the liability to set a precedent over which they had complete jurisdiction to alter, accept, or reject, and generally to deal with without reference to their origin, just as if they had been part of a provisional order originally, and had been put there without any consent between the company and the local authorities. In fact, the agreements must be torn up or disregarded or dealt with in such a manner that they must not stand in the way of a state-manlike and general settlement of the electric lighting in the Metropolis. If there were special circumstances the agreements should be set aside, and really the whole of the agreements bristled with special circumstances which warranted the interference of the Board of Trade. They were no mere consent or assent, but they were laboured attempts to re-construct an Act of Parliament under the guise of a modified consent of the local authorities and the inspector should never pass the order in the form in which it was presented. There being special circumstances, the Board of Trade should interfere as against the local authority. According to the agreements, the general law of the land would be seriously over-ridden. One of the special circumstances in the case was that the inquiry covered a field of which the Strand and St. Marylebone were only parts, and the reason was so special that he hoped local authorities would be told that they could not do as they pleased. He believed that electricity could be best supplied by large and powerful companies, whatever was the particular method of supply. And outside the Strand and St. Marylebone the principle of competition was admitted as well as the corporation admitted it. In settling the supply of the electric light for London, the Board of Trade must have a perfectly free hand to map out that part of London which was affected by the orders; but if the claim of the Strand and St. Marylebone were allowed, that would interpose a veto against the Board of Trade so mapping out London for lighting. It would be a very serious contingency for the Board to allow the small local authorities to hamper the system of the London Corporation by standing out and making separate agreements. He questioned whether on public grounds those local bodies really represented the views of the people who would require the light and who were supposed only to want to get their supply of electricity from the mains of the Metropolitan Company. The statute did not give the local authority finality simply because there were special circumstances in the case. It would be seen after all the evidence and from what he had said, that it looked very much as if the system of the London Corporation would prove to be the best for the Metropolis, and he thought it would be ultimately shown that a large station outside of London for supplying London with light was much better than stations inside the town, and that system he believed would show such advantages that it would be ultimately adopted. In fact, he had already noticed in the room a growing belief that that was likely to be the case. He did not wish to have London as a monopoly for the Corporation, but they ought not to be excluded by agreements made such as he had referred to. Instead of looking upon them as final they should be regarded by the Board of Trade with great suspicion, for they were far too narrow and were contrary to the policy of Parliament. Such antecedent negotiation was bad, and should be neither encouraged or allowed. Besides, competition to be fair should be universal. He felt bound to lay great stress upon the public interest because he had to look after the public, and as theirs was the best system of supply they would obtain a great deal of support from the public. A good deal had been made about the fact that his corporation were going to bring their mains along the railway lines, and the London County Council seemed anxious that it should be stated that such a proposal did not do away with the right of the company to lay mains along the roads. They intended to do this, if only the railway companies enabled them to work, without losing a year. Then, as regarded the City authorities, due consideration would be given to their objections, but still he contended that the city must be dealt with by the Board of Trade and Parliament just in the same way as the other portions of the metropolis. In conclusion he urged that the order of his corporation might be granted.

The Inspector then stated that his report on the whole enquiry would be prepared as soon as possible.

Mr. PEARSON, as representing the various counsel cordially thanked the inspector for his very great kindness and for the courtesy he had shown throughout the enquiry.

The enquiry then closed.

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.—May 9th, 1889.

AUTHORIZED abstract of discussion on Dr. LODGE'S PAPER "On Lightning, Lightning Conductors, and Lightning Protectors."

In opening the discussion, Mr. PEARSON said he did not wish to appear as antagonist of Dr. Lodge, but as a defender of the Lightning Rod Conference, and the "older electricians," and as an advocate of "experience" as distinguished from "theory." Those of the older school were guided by and had a great veneration for facts, whereas the deductions of theory were based on assumptions guided by mathematics, and were not always true. Referring to Case a (steady strain), he contended that no difference of opinion existed, and that this was the case taken up by the conference. With regard to the relative merits of iron and copper for conductors, the conference considered the question judicially, and recommended copper chiefly because of its greater durability. He, himself, always advocated iron, and considered a No. 4 galvanised wire amply sufficient for ordinary conductors. As a proof that self-induction was not ignored by the conference a passage from the report was quoted, which states that the suddenness of lightning discharges affects the conductivity. Coming to Case b (impulsive rush), great difference of opinion exists. Though he had no doubt about the reality of the phenomena shown in Dr. Lodge's experiments by the aid of Wimshurst's machine, yet, he contended that the deductions drawn from them were not necessarily true, that Leyden jar discharges were not comparable with lightning flashes, and that the tin plates used to represent clouds differed greatly in conductivity from clouds which, on the authority of Dr. Lodge, are very imperfect conductors. He considered that the conditions of the experiments more nearly imitated a broken conductor, and mentioned that many similar experiments were made 40 years ago by Mr. Andrew Cross. As regards the oscillatory character of discharges, all agreed that Dr. Lodge had shown that Leyden jar discharges could be made oscillatory by introducing self-induction, but he (Mr. Preece) thought there was no conclusive evidence that lightning flashes were so. On the contrary, telegraphic records of flashes made by Bain's chemical system, Thomson's recorder, and Wheatstone's receiver, show no signs of oscillation. A recent case was described in which a Wheatstone receiver was kept running during a thunderstorm in Anglessea on Sunday the 5th inst. and the resulting tape was exhibited. Further evidence of the unidirectional character of the current was said to be afforded by the signs of electrolysis exhibited by some conductors which had been broken by flashes. He had also examined wires felled by lightning, in which the fusion appeared to have started in the interior, whereas, according to Dr. Lodge, the current is confined to the outer layer. This, the speaker submitted, tended to disprove the theory of deductions, and thought that the fact of telegraphic instruments always being fused inside the coils pointed in the same direction. Referring to lightning protectors in general use, experience proved that instead of such things being of the "most utterly imperfect kind," they were of immense service, for in the Navy no accident had been recorded since 1873, and in the Post Office Telegraphs not a single pole out of half a million had been damaged. In 1873, before the instruments were fitted with protectors, 19 per cent. of the instruments in use were damaged, but now the percentage is reduced to 1.3, and this he believed due to the non-protected instruments still in use. Several conclusions of the Lightning Rod Conference had been severely criticised by Dr. Lodge in Section 89 of his paper, particularly those relating to the protection afforded by well-earthed conductors, and in reply to this criticism Mr. Preece said he was quite prepared to clasp a good conductor during a storm or even to sit on a barrel of gunpowder through which the conductor passed.

Mr. C. W. VINCENT, speaking of oscillations, said that he assisted Faraday in making experiments on the discharge of a large Leyden battery through various materials, but no signs of oscillation were noticed, although cases of intermittent discharge were frequently detected.

Mr. FARQUHARSON described a singular case of damage to H.M.S. *Coquette*, in which part of the conductor passing from the mast to the copper sheathing of the vessel was torn away from the beam to which it had been attached. The only defect found in the conductor was a bad joint near the top, and he could never understand how this defect could cause the observed effect.

Mr. J. WIMSHURST considered that there was nothing very new in the impulsive rush, for he had been acquainted with it for some years. As regards the protection afforded by points against an impulsive rush, this depended greatly on whether the cloud was positively or negatively electrified. To show this, a dome and point were placed on the lower of two insulated metal plates and Leyden jars discharged into the upper. When the top plate was + the point was struck equally with the dome when both were at the same height, but when the electrification was reversed the point afforded the greater protection. This difference is of consequence in Dr. Lodge's "bye-pass" experiments; and he (Mr. Wimshurst) had found that putting on the bye-pass reversed the direction of the spark across the air space.

Prof. W. G. ADAMS said that as chairman of the Lightning Rod Conference, he thought the work done by that body had been misrepresented and unfairly criticised, for its objects were to examine and report on what was then known on the subject, and to

condense existing knowledge so as to form a scientific basis for future practice, and these objects he considered were well carried out. He acknowledged that Leyden jar discharges produced remarkable effects then unthought of, but considered the statement that lightning flashes were strictly analogous, unproved. As illustrating the truth of the older views, the case of the Brussels Town Hall was cited. This building, although elaborately protected on M. Melsen's system, has been recently struck, thus proving that the adverse opinion expressed by the conference on the system adopted to be well founded. Another case, in which the views of the conference received confirmation, occurred at the South Foreland Lighthouse in 1885. The flash struck the lantern, leaped to the electric lamp, passed through a long cable to the magneto machines, and thence by way of the engine room conductor to a well 280 feet deep, into which the conductor was earthed. The lighthouse conductor, where seen, was in perfect order, but the earth plate was found buried about 18 inches below a gravel path, resting on dry chalk. A man standing within a foot of the spark as it passed to the electric lamp felt no shock.

Prof. FITZGERALD, on rising, said he had said nearly all he had to say at Bath, but he wished to point out that the data now brought forward by Mr. Preese did not prove the non-existence of oscillations, for in all discharges, whether oscillatory or not, there is a definite flow in one direction which would produce the telegraphic records. Referring to Dr. Lodge's paper, he said the weak point was the assumption that clouds behaved like good conductors, for it was well known that in horizontal directions they were very bad conductors. Of course it was possible that a shower might make them good conductors vertically, but this was a point on which no reliable data existed. Before Dr. Lodge's experiments, the speaker said it would have been very difficult to account for the setting fire to the Hôtel de Ville at Brussels by sparks from an isolated bar of metal, and although the Lightning Rod Conference had done much good work, there were still many obscure points requiring experimental examination.

At this stage of the discussion Dr. LODGE (who is unable to attend the next meeting) briefly replied to some of the questions raised. With regard to experience v. theory, he considered that theory guided by experiment more likely to make progress than unguided experience. Owing to lack of theory, Edison called into existence "Ethereic force to explain phenomena of a character similar to those produced by electric surges," and M. Mascart had observed similar phenomena but had not described them, because he could not understand them. Mr. Preese had said that no difference existed between them as regards case a, but this, Dr. Lodge thought, was not correct, for he maintained that surges occur in case a as well as in case b, and he could not admit that when there was no oscillation there was no self-induction, for self-induction existed in every circuit. Judging from Preese and Sivewright's Telegraphy, he concluded that lightning protection frequently failed, and, to be really efficient, no single failure should occur. Referring to Mr. Wimshurst's experiment, he said that he had not noticed any difference between the different protective effect of points with charges of opposite sign, for he never troubled himself about the matter of sign. In conclusion, Dr. Lodge expressed his opinion that the Lightning Rod Conference did much good work, and regretted that he should have seemed antagonistic towards it.

The discussion was then adjourned to May 16th, when Mr. Wimshurst proposes showing his direction "analyser" in action, as well as other experiments bearing on the subject under discussion.

NEW PATENTS—1889.

6316. "An improvement in electrical contact makers or switches or connectors for the passage of a current of electricity." H. S. NOWELL. Dated April 15.

6423. "Improvements in electrical motors and apparatus connected therewith, especially applicable to purposes of locomotion." A. J. JARMAN. Dated April 15. (Complete.)

6458. "Method of regulating the electric current produced by an electric machine driven by a motor having an irregular or varying speed." F. HONO. Dated April 15.

6527. "Improvements relating to electro-motors." H. H. LAKE. (Communicated by N. Tesla, United States.) Dated April 16. (Complete.)

6547. "Automatic circuit controllers for electric circuits." S. C. C. CURRIE. Dated April 16. (Complete.)

6568. "Improvements in dynamo-electric generators and motors." G. E. DORMAN. Dated April 17.

6569. "Improvements in dynamo-electric generators and motors." G. E. DORMAN. Dated April 17.

6570. "Improvements in dynamo-electric generators and motors." G. E. DORMAN. Dated April 17.

6571. "Improvements in dynamo-electric generators and motors." G. E. DORMAN. Dated April 17.

6572. "Improvements in dynamo-electric generators and motors." G. E. DORMAN. Dated April 17.

6579. "A combined insulator and final and lightning wire for telephone, telegraph, or other electric wires." H. F. JACKSON, A. COLEMAN, and P. LOFTUS. Dated April 17. (Complete.)

6600. "Improved method and means of obtaining electricity." W. ROBERT. Dated April 17.

6623. "Improvements in electrical switches, fuses, cut-outs, ceiling roses, lamp holders, and the like." F. G. HOWARD, J. APPLETON, W. T. BUREY, and A. E. WILLIAMSON. Dated April 18. (Complete.)

6628. "Improvements in laying and insulating mains for conveying electricity." W. H. SCOTT and LAURENCE, PARIS and SCOTT. Dated April 18.

6631. "Improvements in machines for bevelling stereotype and electrotype plates." J. MANNING. Dated April 18. (Complete.)

6675. "Improvements in electrically-driven fans." H. G. WATTEL. Dated April 18.

6713. "Improvements in electric lamp fittings." W. H. STRUBB. Dated April 20.

6738. "Improvements in the method of and means for the distribution of electrical energy by alternating currents." G. KAPP. Dated April 20.

6745. "Improvement in the method of and means for electrolysis of substances in a state of fusion." M. KILIANI. Dated April 20.

6804. "Improvements in telephone transmitters." W. R. LAKE. (Communicated by J. Straton, Canada.) Dated April 21. (Complete.)

6847. "Improvements in meters for registering the passage of electric currents." G. E. DORMAN. Dated April 24.

6867. "Improvements in 'holders' for incandescent electric lamps." C. RICHARDSON and G. HILL. Dated April 24.

6869. "An improvement in the casings or covers of electric switches, cut-outs, and wall and ceiling fittings." J. S. LEWIS. Dated April 24.

6875. "An improved construction and mounting of the spring armature and hammer for electric bells and other like electrical instruments." J. C. WILLIAMSON. Dated April 24.

6884. "Improvements in the means of obtaining motive power from alternating currents of electricity." L. B. ATKINSON. Dated April 25.

6885. "Improvements in apparatus for use with variable currents, and in the means of obtaining motive power from alternating currents of electricity." L. B. ATKINSON. Dated April 25.

6954. "Improvements in meters for registering the passage of electric currents." G. E. DORMAN. Dated April 26.

6974. "Improvements in regulators for controlling the production and utilisation of electric currents." G. E. DORMAN. Dated April 26.

7002. "Improvements in electric secondary or storage batteries." T. H. HICKS. Dated April 26. (Complete.)

7023. "Improvements in electric meters." R. SNOWDON. Dated April 27.

7037. "Improvements in electricity meters." J. BLYTH. Dated April 27.

7038. "Improvements in electric battery cells for lighting or for other purposes." W. BALCH. Dated April 27.

7088. "Improvements in electric measuring instruments." R. SNOWDON. Dated April 29.

7108. "Improvements in safety devices for high voltage circuits." B. M. DRAKE and J. M. GORHAM. Dated April 29.

7127. "Improvements in or connected with the brush contacts of electric railways." G. E. VAUGHAN. (Communicated by S. Trott, Nova Scotia.) Dated April 29.

7129. "Improvements in arc electric lamps." A. J. HOWES. Dated April 29. (Complete.)

7133. "Improvements in electric meters." A. RECKENHAUSEN. Dated April 29.

7138. "Improvements in and connected with electric glow lamps." A. W. FITCH. (Communicated by R. O. G. Drummond, South Africa.) Dated April 29.

7165. "Apparatus for electrical distribution of energy." J. M. MUNRO. Dated April 30.

7198. "Improvements in the manufacture of electric arc carbons." W. E. ADENY and L. SAUNDERSON. Dated April 30.

7215. "Improvements in secondary batteries." C. B. ASKEW and J. K. PUMPELLY. Dated April 30. (Complete.)

7275. "Improvements in arc lamps." S. Z. de FERRANTI. Dated May 1.

7336. "Improvements in apparatus for electrical communication for trains and similar purposes." A. C. COCKBURN and J. N. COOPER. Dated May 2.

7337. "Improvements in electric winding and striking clocks." J. JACOBIN. Dated May 2. (Complete.)

7349. "Improvements in the method and means of working the driving appliances on electrically propelled vehicles." M. E. WARD. Dated May 2.

7395. "Improvements in or relating to commutating alternating currents of electricity." W. S. BOULT. Dated May 3.

7416. "Improvements in devices and apparatus for controlling and regulating motive power for various purposes, but having especial reference to the use of electric motors for training heavy guns." B. J. B. MILLS. (Communicated by B. A. Fiske, United States.) Dated May 3.

7483. "Improved means or apparatus for driving rotary hair brushes and the like by electricity." H. J. DOWLING and H. S. PACE. Dated May 3.

7484. "Improvements relating to electric accumulators or secondary batteries, and to the manufacture of plates or electrodes therefor." C. POLLAK. Dated May 3.

7473. "Improvements in switch apparatus for electrical circuits." C. A. McEVOL. Dated May 4.

7507. "Improvements in mechanically and electrically working, repeating, and inter-locking railway points and signal apparatus in conjunction with block instruments and the lighting of signal and station lamps." I. A. THOMAS. Dated May 4.

ABSTRACTS

OF PUBLISHED SPECIFICATIONS, 1889.

30. "Improvements relating to electric telegraphy." M. W. DUNST. Dated January 1. 8d. Claim:—In an electro-harmonic system a plurality of manipulative transmitters arranged to be operated either separately or two or more simultaneously by one person, and a corresponding number of printers or markers, actuated respectively by the aforesaid transmitters, and arranged at right angles to the line of travel of the paper, and to produce by the simultaneous action of two or more of said printers or markers a corresponding number of marks in a row at right angles to the travel of the paper, and the rows of marks so disposed representing a letter or character, as set forth.

46. "An improved thermo-electric generator." W. S. DE LAUN ROBERTS and J. S. MOLLISON. Dated January 1. 8d. The first part of the invention consists of a stove or furnace which is surrounded by an air-tight hot-air chamber, the outer walls of which are composed of any suitable non-combustible insulating material (preferably a mixture of fire clay and asbestos). The couples are so inserted into the insulating wall that for a portion of their length they shall project into the hot air chamber. The heat in this chamber is regulated by a pyro safety valve fixed in any convenient position in the upper part of the chamber. All risk of overheating the chamber will thus be avoided, and a uniform heat imparted to the couples that project within the hot-air chamber. The invention further relates to a novel mode of making the thermo-electric couples, without any joint or soldering at the junction of the metals. This is effected during the process of casting by fusing the two metals together. By adopting this mode of forming the couples the inconvenience hitherto experienced from the extra resistance and consequent diminution of the electric current, due to the loosening of the joint by unequal expansion and contraction of the metals, will entirely cease. The claims are 3 in number.

118. "Improvements in electric brakes for railway trains." W. P. WIDFIELD and A. H. BOWMAN. Dated January 3. 8d. Relates to an electric brake system, in which the rotary momentum of the car axle is automatically communicated to the brake lever through the medium of simple mechanism and in electric circuit. The claims are 14 in number.

180. "Improvements in armature winding for dynamo-electric machines." W. H. KNIGHT. (Under international convention.) Complete specification accepted February 16, 1889. 8d. Consists in making up the winding into a mat, which may be made by machinery, and then applying the same to the ordinary cylindrical core of magnetic material. The claims are 10 in number.

278. "Lightning arrester for telegraphic purposes." G. WEHR. Dated January 7. 6d. Claims:—1. A lightning conductor or arrester consisting of a metallic cylinder provided with horizontal or vertical ribs, or furrows, and of another hollow cylinder which is provided on its inner sides with ribs, or furrows, in such a manner that the ribs of the two cylinders may cross one another and hence present a great number of passages to the atmospheric electricity, as described, the construction being substantially as shown by the drawings. 2. In the construction of a lightning conductor or arrester an inner cylinder in two or more parts, insulated from one another for the purpose of connecting two or more circuits to the same appliance, as described. 3. The insulation and the hermetic closure of the two cylinders and by means of the two pieces of ebonite and of the India-rubber ring, as and for the purposes set forth.

362. "Improved methods of and apparatus for welding, shaping, and otherwise working metals by the aid of electricity." H. H. LAKE. (Communicated from abroad by Prof. Elihu Thomson, of America.) Dated January 8. 8d. The invention consists chiefly in passing a heavy electric current through the part of the bar or other piece to be operated upon so as to bring such part to a working heat, irrespective of the other portions not to be forged or otherwise treated, and then shaping by pressure, or by hammering, or other convenient application of force to effect an upsetting operation, and in such a manner as to move the heated particles in the direction required to give the work the intended or desired form. It also relates to apparatus in connection therewith. The claims are 5 in number.

CORRESPONDENCE.

Hemp v. Iron for Ocean Cables.

My first letter was hurriedly written for a local paper in consequence of a rumour here that a large Government subsidy was to be given towards laying a cable to connect this garrison with the naval station at Bermuda. In replying to your attack upon that letter I was again necessarily hurried to catch the mail to England. And now, on returning to town, I have but an hour to reply to your carefully prepared article in your issue of the 5th instant.

All this necessary haste to prevent a controversy from becoming stale will be remedied upon the adoption of hempen cables and cheap telegraphy which will, I trust, lighten all mail bags, and after which your valuable articles may appear on this side of the ocean at once, to be replied to on the other side, if necessary, without delay.

The comments elicited by my first very plain letter have, as one electrical journalist expressed it, been "amazing." This and the large number of letters I have received, some of them from distinguished public men who take an interest in the subject, have been quite a surprise to me; but what surprises me more is, that only from your journal have I received any influential opposition.

However, in calmly reviewing the controversy in the light of what you have formerly said on the subject, I really do not see why any great difference should exist between us. I do not understand that you deny, but, on the contrary, I understand you have admitted that hemp lasts in the deep sea much longer than iron, and that under certain conditions is practically indestructible, and that the chafing against rocks, which necessarily takes place in shallow water cannot happen at great depths, and that, in fact, the permanence of hemp can be thoroughly assured under all conditions met with in deep-sea routes.

Now, if you will go one step further and admit that the feasibility of the general idea of the substitution of hemp sheathing only instead of iron armour should be tested by laying a hempen cable, or even that no more public money should be spent without proper enquiry, I shall have no further cause of controversy with you.

You need not take the trouble, as you do, to apologise for your "severe criticism," because the only thing in the controversy I care a fig for is to detect any fallacy in the chain of reasoning which has led to my present views, or, in other words, whether any sound argument can be adduced against the superiority of hemp over iron for sheathing for ocean cables.

You say I may object that your testimony is somewhat out of date. Assuredly. I hope you will not consider me arrogant when I say I am familiar with the old cases where hemp is supposed to have failed, and, perhaps, I may in the future refer to them in detail. For the present permit me to say that the recent improved hempen cable adopted by the Anglo-American Company for repairs in the Atlantic is perfectly free from "knuckling," and the Halifax-Dartmouth cable of the same type has not in eight years "shrunk" in the very slightest degree. The former is an improvement upon the latter, and I have no doubt it may be still further reformed.

Do you not consider it unfair and likely to mislead to quote perpetually the failures of many years ago without pointing out the difference between the hempen cable of to-day and those which were doomed to miscarriage and failure? At that time pioneers in both iron and hemp were courageously feeling their way in the fogs of ocean telegraphy, and both were making huge mistakes. You never refer to the long series of blunders and calamities which have down to the present hour befallen the iron-sheathed lines and entailed the loss of millions.

The Candia-Alexandria cable of 1858, cited by you, I think you must admit no more resembles the strong, compact, and impervious cable which now bears

testimony from the depths of the Atlantic, than the rude canoe of the aboriginal red-man resembles the *Sunbeam*.

I may be "fanatical," as you are pleased to say, and possibly lead the public astray; but in respect to the Dartmouth-Halifax cable, though I myself approached it at first with caution, I regard it now as a "trump card," and without it you evidently would show me no mercy. I must remind you that at first you declared it was carefully laid by its inventors in a safe position, I think you said on a bed of mud; but since I have convinced you that the metals which would be fatal to iron prevail on the bottom, the place is swarming with insect life, and the cable is subjected to strong currents, you seem to be showing more respect for it, and I feel certain that if you were to do Halifax the honour of personally inspecting this modest hempen line, your behaviour towards it would become quite unexceptionable.

I have not now time to examine the Parliamentary evidence to which you refer, and to which I have access; but will you mention in what instance hemp has been destroyed by vegetable matter in the deep ocean? You will hardly accept any such statement without further enquiry.

One of your arguments against a hempen cable is that the tar necessary to preserve the hemp will injure the gutta-percha; but I find, on examination of the new type of cable, that the tar does not come in contact with the gutta-percha.

Galvanising the wire, you contend, preserves it, as tar does the hemp. Galvanising the wire postpones but briefly its destruction; while tar, and especially the proper compound, is likely to postpone indefinitely the destruction of hemp.

Why should you suspect that I am not making full disclosure respecting the facility with which a hempen cable may be raised? I was very explicit in urging that the question may be set at rest by a single practical test.

Mr. Kennelly, you assert, has disposed of the question of loss of speed. I doubt whether that gentleman will take such high ground, and I am quite content that the question should remain in abeyance—should science not sooner solve it until the laying of the first hempen cable.

Lastly, I desire to say that every other feature and circumstance of this controversy, in my view, sink into nothingness compared with what I call the "resilience" argument—that is the argument arising from the recoil of the steel or iron wires of an armored cable. And I much regret that you seem entirely to have misunderstood that part of the case. What I urge is, that the evidence shows conclusively that in almost every instance of casualty to cables in the ocean, rupture and interruption are caused not by *mechanical* but by *chemical* action. In other words, the wires having in numerous places become diminished by corrosion—the adjacent cable maintaining its due strength—at length suddenly part, whereupon on either side of the fracture by reason of the stored up resilience in the intact wires, they turn or twist violently in opposite directions and wring the core asunder.

I do not mean to say that in recovering the cable, sometimes dragging the end over the ground in the deep sea does not produce abrasion, but abrasion is not the cause of the rupture. That is the result practically always of corrosion of the iron wires by which sudden torsion of the core parts the cable.

This is the manner, as I assert, in which the core becomes destroyed, and not, as you misinterpret me, by corrosion of the gutta-percha, which is absurd.

Science without the aid of experiment or practical example might have disclosed this to us; but experiments and years of experience have confirmed what was first discovered and announced by Captain Trott and Mr. Hamilton—now in London—of the cable ship *Minia*, at a meeting of the Society of Electricians in 1883.

At that time the advocates of iron sheathed cables managed to monopolise the discussion, practically

shutting out the adherents of the hempen type from replying, as was chivalrously pointed out by the *ELECTRICAL REVIEW* at the time. Men of great influence in the meeting arrogantly denied that such a thing as torsion ever happened. This is the mode by which the gigantic profits of construction companies and miserable returns of telegraph companies have been perpetuated.

You now, in reply to my argument respecting torsion, seem to say that "a hempen rope would behave in the same manner." You certainly cannot mean to say that the stored up force of a hempen cable would be sufficient to produce torsion in case of the rotting of the hemp to rupture the core. Therefore it is evident you have entirely misconceived the argument; and I can say that I have strong hopes when this part of the argument which, owing to the obscurity in which I presented it, dawns upon your mind, you will no longer oppose official and full enquiry.

Even if hemp were not more durable than iron, inasmuch as its disintegration will not have the fatal effect of twisting off the core, the gutta-percha covering will remain, growing harder with time, and still continue to furnish a practically indestructible line in the deep sea. This, at any rate, is what all practical disinterested engineers and experienced sailors assure me will be the remarkable and satisfactory result, as I intend further to explain on some future occasion.

With the hempen covering alone the chances of requiring to raise the cable are vastly less than in the case of an iron sheathing. And since in many cases where the wires having rusted their hempen covering and having been eaten into short pieces, cables have been raised with all this dead weight by the mere strength of the core serving of yarns alone, it seems clear that the chances also of recovering the hempen-sheathed cable, if ever required, would be much greater than in the case of the core covered with more perishable wires. If, therefore, this contention respecting resilience, of which I cannot doubt, can be maintained, all our minor causes of controversy become conspicuously insignificant.

Robt. L. Weatherbe.

Halifax, Nova Scotia,
April 27th, 1889.

Re Oxygen at Red-Heat.

If you think the following remarks worthy of attention, perhaps you will kindly find room for their insertion in your valuable columns. The recent discovery that oxygen loses its normal powers when "dried," or rather when its temperature is raised to that of red-heat, is certainly a peculiar and unexpected fact, and it is said at present to puzzle chemists to account for the same. I would propose a line of possible solution, from analogy. Let us consider oxygen under its magnetic and electrical conditions. Water we know is a composition of the gases oxygen and hydrogen, and since they thus combine, one is magnetically positive, and the other negative. Suppose a zinc and a carbon plate to be placed in water acidulated by sulphuric acid, what is the positions? Both are electrified; the negative oxygen inclines to the positive zinc plate, and the positive hydrogen inclines to the negative carbon plate. Nothing can be seen till we connect the poles of these plates, then we at once perceive hydrogen bubbles about the carbon, and we know that the oxygen is attacking the zinc, forming an oxide, which is instantly reconverted into a sulphate of that metal. This is the normal action. Now let us consider the action of a horseshoe magnet upon a piece of iron. Well, the substance being magnetic is attracted by the magnet; but if you make the poles of the magnet red-hot, you destroy for a time its magnetic power, probably from the action of the heat which has proved to be sufficient to cause the molecular magnets of which the entire magnet consists, to be mixed up, and so to bind each other while expanding. Here, then, a red-heat has caused a confusion of the arrangement of the atoms forming the magnet. I would suggest that it is perhaps possible that the normal magnetic conditions have been similarly con-

used or even inverted in the case of oxygen similarly raised in temperature. That the iron appears as a mass of atoms, while the oxygen in a gas, does not, I conceive, in any way affect the analogy. The matter will no doubt receive full attention from those more competent than I to deal with it, but this view of the subject might not be wholly without interest to some of your readers.

L. V.

May 11th, 1889.

Alternating Current Motors.

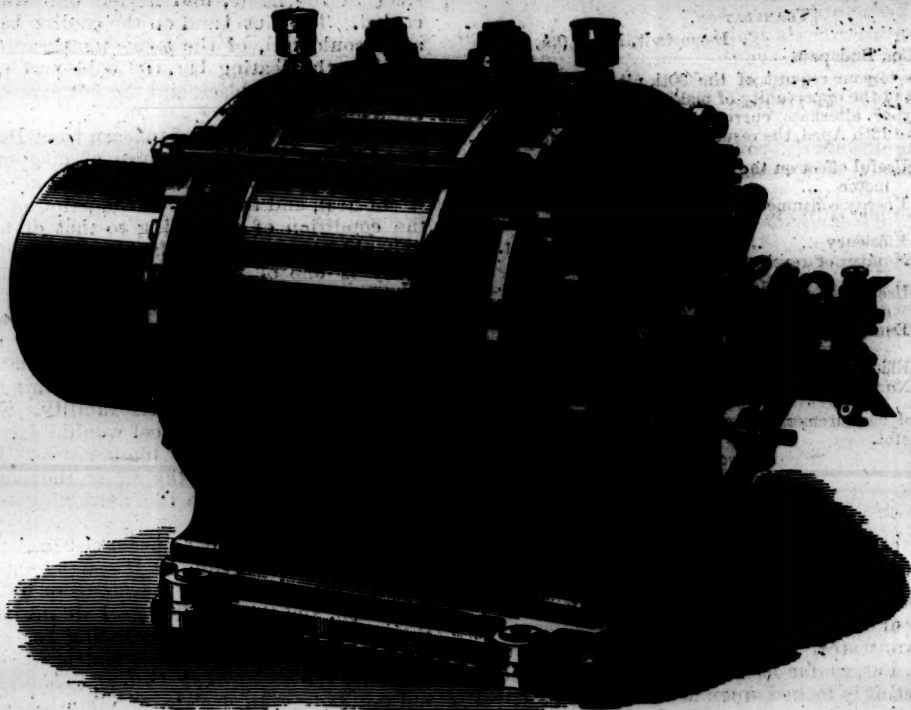
In your editorial of April 26th there appeared, on page 467, some remarks upon our alternating current motor to which we take the liberty of answering.

We are completely of your opinion that it would have been far more interesting to everybody to receive a general description of the alternate current motor together with the data which we published, but commercial interests still prevent us publishing the desired description, which we must reserve for some later time.

terminals of the alternate current motor and at those of the continuous current dynamo were measured electrically by suitable wattmeters. The efficiency of the motor was then calculated under the assumption that the efficiency of the continuous current dynamo was 94 per cent, even when the output of the dynamo was much less than normal. This assumption seems a rather unfavourable one, as it is obvious that the efficiency of the motor would have turned out greater had a lower efficiency been assumed for the continuous current dynamo.

To remove all your doubts we have received the following results:—

Turns per min.	Output of motor.		Energy apparently consumed.		Energy effectively consumed.		Ratio of watts actually consumed to apparent watt-amperes.	Commercial efficiency per cent.
	H.P.	Watts.	Watt-amperes.	Watts.	H.P.	Watts.		
600	15	11,000	18,000	15,800	21.5	11,000	0.88	77
700	19.8	14,000	24,300	18,800	25.2	14,000	0.77	79.5
730	30.4	22,400	39,800	27,700	37.6	22,400	0.63	80.9



GANE & Co.'s ALTERNATING CURRENT MOTOR.

Upon your remark that we are still awaiting the success of our motors, and that the published figures are only what we are aiming at, we must ascertain that these data have been measured in fact.

Permit us here to remark that your doubt upon the exactness of the figures, given by us, do not at all seem consistent with our character, for never have we published any figures which did not depend upon exact facts, and which have not fully been confirmed in practice.

We avoid sending into the world our desires as closed facts, as is usual in some places, and we might therefore have expected that our trustworthiness would not so easily be doubted by a journal as esteemed and far spread as yours.

As to your wish to have our figures expressed in other values, viz., in brake power and electrical energy consumed instead of watts and electrical horse-power, we must answer that our figures have been obtained by means of exact measurements, easy to be performed, and which seem far more reliable than the results received by braking.

The motor being belted to one of our continuous current dynamos, type A₁, the energy available at the

We mention that Prof. Dr. E. Kittler, of Darmstadt, the well-known high authority in all electrical matters, happened to be present at one set of our tests of the motor, and had occasion to prove the exactness of our above given figures. Enclosed you will find his own words.

Moreover, we can tell you that there will soon be occasion to see an electrical plant for the transmission of power by means of alternate current motors at work. We are erecting this plant at the "Brauhoof," at Wiener Neusadt, and can give you the following details:—

The plant is being built upon the inducement of Mr. Max von Bernd, electrician, who had occasion to assist at some trials in our factory and to convince himself of the justness of the figures we have now published. It will serve, preliminarily, for the utilization of an 80 H.P. water-power for the lighting up of the Wiener-Neustädter Brauhoof with about 200 incandescent lamps, and for the working of the different machines of the brewery.

It will comprise, therefore, preliminarily, two electro-motors of 10 horse-power each, and a smaller one of 5 horse-power. One of our alternate current dynamos of newest design, type A₁, with an output of 25 amperes

[We have replied to this in "Notes."—EDS. ELEC. REV.]

